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Greater Productivity for Progress

"OURS is the most basic industry of all," says the steelman. "Look around you! There isn't a manufactured article you can see or touch that does not depend in some way on iron and steel." But to remind our friend from Pittsburgh that chemical and chemical engineering processes underlie even those of his blast furnaces and open hearths carries little conviction. He also knows that his mill cannot run without the coal needed for the coke ovens that supply so many chemical raw materials. All our heavy industries are so interdependent that one cannot be retarded without crippling the other. So a steel strike becomes our business, and conversely, our progress depends in large measure upon the broader advances of industry as a whole.

This is why it makes sense for all of us to ponder seriously over the thought behind the plan proposed at the year-end by Charles E. Wilson of General Electric. He was sure that a one-year moratorium on price and wage increases, on the one hand, and on strikes and work stoppages, on the other, would give the labor-industry team the opportunity it needs to pull together for the benefit of all. Certainly a full year's production of all commodities would go a long way toward solving most of our current problems. It would give labor the higher *real* wages it now seeks by dubious and selfish tactics. It would give all of us lower *real* prices, thus helping to put an end to the inflation that is devaluating our insurance policies and life savings. It would give us the higher level of stabilized employment that is essential to higher living standards. And, finally, it would help to build back the mutual trust between management and labor that is so badly needed in American industry.

Part of our difficulty, it seems to us, is the failure to realize that production is our most basic need—that it must come first in the stabilization process. We should remember that the product itself must pay for its costs, including the labor that goes into it. To fight over wages and prices while machines stand idle is futile. No one gains if strikes of workers or buyers throttle production in key industries.

Fortunately the chemical process industries are presently operating at a level at least ten percent higher than a year ago. Deferred demands plus normal needs are such that it will take another twelve months to catch up, provided there is no further interruption in production. Meanwhile, a boom in new chemical plant construction is calling for more equipment and raw materials than were needed for the peak of wartime building.

Prices may prove a determining factor in our progress during the next few months. If they rise too sharply they can and will deter buying and curtail further business activities. But if it is possible, as Mr. Wilson hopes, for labor and management to keep wages and prices in line during the next twelve months, we can make 1947 a record year. Scarcities will disappear with production. If we can get back to work on a more efficient basis, costs can be lowered to benefit the worker through lower prices and higher real wages. Thus the only sure basis on which we can expect to make progress is in the universal application of the simplest of all economic doctrines of American industry—more goods for more people at lower costs.

Chemical engineers have a serious responsibility in this connection. Directly or indirectly they must initiate and improve the methods and equipment that will lead to ever greater productivity in the process industries. Seldom has there been a time when technological advances can make a greater contribution to the common good.

GRAPHITE HEAT EXCHANGERS

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A TEN YEAR ENGINEERING REVIEW OF IMPERVIOUS GRAPHITE'S RECORD AS A MATERIAL FOR THE CONSTRUCTION OF HEAT EXCHANGERS

IT HAS often been stated that the leading problem in chemical engineering today is that of heat transfer. The problem of heat exchange becomes even more difficult and complex when corrosive fluids must be carried in the equipment, for a high degree of heat transfer must be combined with chemical inertness of the construction material employed. It was a search for this combination of properties that led to the wide use of impervious graphite in heat exchange equipment for the chemical process industries, for few materials of construction, as is shown in accompanying tables, have the wide range of chemical resistance or the efficiency of heat transfer possessed by this element.

Carbon and graphite in the form in which they are originally fabricated have, however, a porosity of about 15-25 percent, which necessarily precludes their use in this state for piping, heat exchanger tubes and similar applications where the leakage must be zero.

In order to utilize the chemical inertness inherent in the element carbon without altering its thermal conductivity, an impregnation is effected with three standard resin formulas of phenolic, modified phenolic, or furfural base. The resins are cured in the pores of the stock after manufacture. By selecting the proper resin, impervious carbon or graphite equipment is made for use under practically all the corrosive conditions which the basic stock will endure. Moreover, the low coefficient of expansion of these products (about one quarter that of cast iron) gives them exceptional resistance to thermal shock, and the good mechanical strength and easy machinability of the materials adapt them to the construction of headers, manifolds, tube sheets, domes, return bends, baffles, towers, pumps, pipes, valves, and other parts of almost any required design.

Corrosion Resistant

Impervious carbon and graphite equipment is resistant to the action of most acids, alkalis, and other corrosive, solvent or reducing agents. At the same time, a wide range of thermal conductivity is available in the product since the stock made from carbon is a fairly good insulator whereas stock made from graphite is higher in thermal conductivity than most metals, being higher than admiralty metal and three times as high as carbon steel.

Of special interest to engineers is the fact that such materials, because of their chemical inertness, are not subject to corrosive scaling. Whereas corrosion promotes the formation or precipitated scales in other materials it will be found that this condition does not apply to an appreciable extent in impervious graphite tubes. Such scale as occurs should be removed by chemical rather than mechanical means, however, as it is usually possible to find a solvent that will remove the scale and impervious graphite will handle nearly all such solvents, though the type of solvent selected will influence the grade of material employed.

It is noteworthy that plates, tubes, or other shapes are not dependent on the impregnant for their strength. This is seldom true with highly alloyed metals where an attack on one element causes structural disintegration to occur, or with non-metallic compounded materials where the bonding agent is dissolved.

Since impervious graphite possesses the unusual combination of chemical inertness and high thermal conductivity, heat transfer equipment for a broad range of corrosive fluids ranging from simple immersion type heat exchangers to relatively large tube bundle units has been fabricated. Cascade type coolers are used extensively for cooling hydrogen chloride and other corrosive gases either with or without simultaneous absorption. Concentric tube exchangers are employed to recover heat from spent solutions by preheating make-up water or chemicals, to ex-

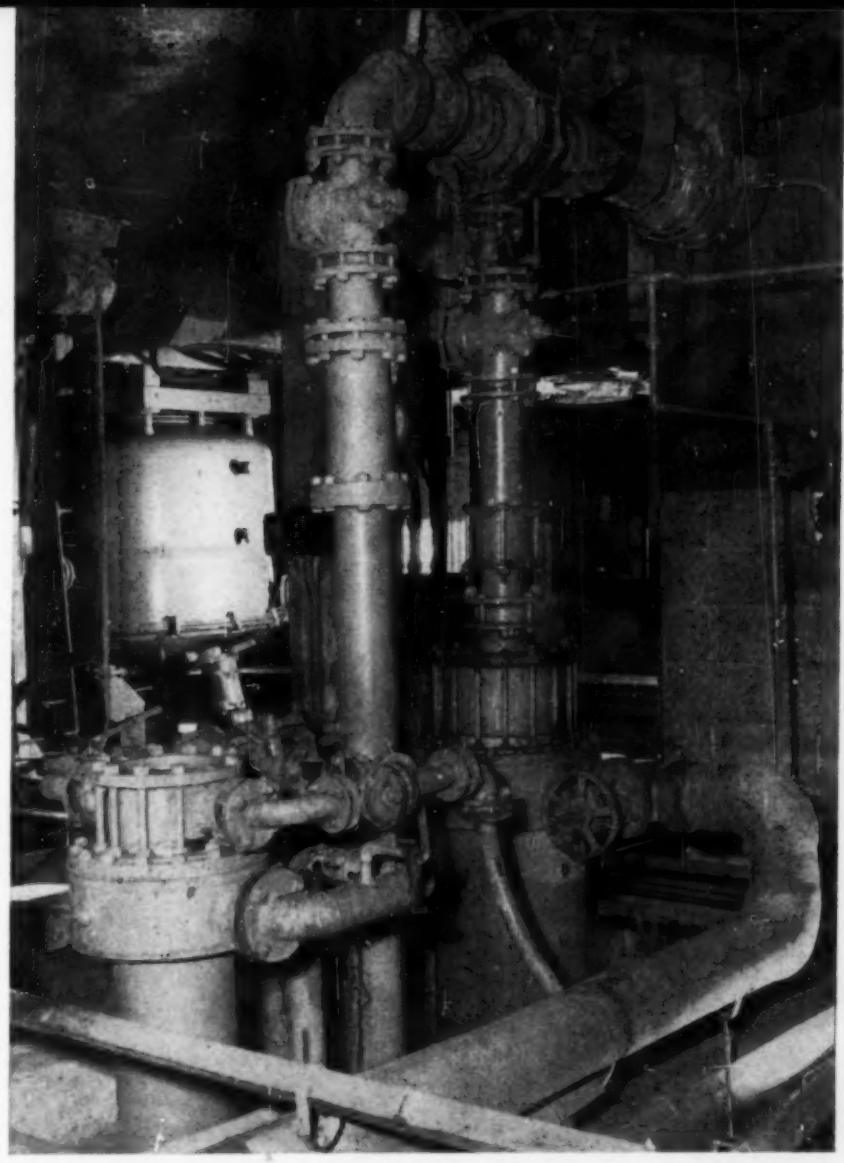
The past ten years have seen impervious graphite heat exchangers move in on the chemical industry in force. This article, the first of two, is concerned with pertinent properties of the material itself. Of particular interest is the review of corrosive services where graphite heat exchangers have done themselves proud. The concluding article will be published in an early issue and will concentrate on design data, as collected from many typical installations.

change heat in various parts of stripping or refrigerating systems, and to absorb hydrogen chloride in water to produce water-white hydrochloric acid free from metallic contamination. Installations of Karbate impervious graphite shell and tube heat exchangers, which are numbered in the hundreds, are used for the heating or cooling of liquids and gases and for unit processes such as boiling, condensing, absorbing and stripping. These units can be mounted in various positions, horizontal, vertical or inclined, depending upon the function it is intended to perform. The breadth of usefulness of these exchangers can be illustrated by the following typical applications, selected from the hundreds of installations made during the periods 1937-41 and 1945-46. The manner in which they are being used, whether as condensers, vaporizers or evaporators, and the chemical conditions under which they are used are described below. These by no means represent all the chemical applications made but only some of the more important ones which can be disclosed.

Acetic Acid—Condensers and boilers. The service was a combination of acetic acid with impurities of hydrobromic acid which resulted in a corrosive condition decidedly more severe than one from acetic acid alone. Preheaters, condensers, and coolers were also used in processing 98 percent acetic acid plus other chemicals.

Ammonium Sulphate—Heaters for replacement of Monel coils. In this particular case slurries of ammonium sulphate have had a tendency to attack both ends of Monel coils, apparently at the cold end by successive erosion by the crystals on the protective film of the metal and subsequent corrosive attack by the solution on the bare metal thus exposed. At the hot end the breakdown is caused by straight corrosion due to the higher temperature.

Ammonium Fluoride—Preheaters were used to replace silver units which had become badly corroded by an ammonium fluoride solution that varied in reaction between alkaline and acid. Impervious graphite tubes, tube sheets, and heads have given satisfactory service for several years without showing any indication of attack. Steam at approximately atmospheric pressure is used on the shell side.



Lower end of heating element for pump recirculation evaporator and lower end of multi-pass cooler. Both have impervious graphite tubes, heads, and tube sheets

Brine Solution (24 Percent) Saturated With Chloride—Heaters. The corrosive factor, of course, is the wet chlorine—highly corrosive to all metals, but only mildly so to impervious graphite equipment in saturated solutions. Under ordinary conditions an economic life can be expected.

Calcium Bisulphite—Heaters. A percentage of free sulphurous acid was always present in the material handled, and smaller amounts of free sulphuric acid probably were present on occasion.

Carbon Disulphide—Cooler and condensers. Used for the recovery of CS_2 in the viscose rayon process.

Carbon Tetrochloride Vapors—Condensers used in the chlorination of rubber in CCl_4 solution. HCl formed.

Carbon Tetrachloride and Water Vapor—Condensers used in the chlorination of rubber. HCl formed.

Carbon Tetrachloride, Chlorine and HCl—Condensers used in the chlorination of rubber.

Caustic Soda (50-Percent)—Heaters. Impervious graphite was used to

Typical Physical Properties

	Apparent Density, Lb./Cu. Ft.	Strength, Lb./Sq. In.			Modulus of Elasticity, Lb./Sq. In.	Izod Impact Strength* Ft. Lb./In. of Notch	Thermal Expansion Coefficient Per ° F.	Thermal Conductivity B.t.u./(Hr.) (Sq. Ft.) (° F./Ft.)
		Tensile	Compressive	Transverse				
Carbon, plain	94	900	7,000	2,700	1.9×10^6	0.27	0.18×10^{-4}	3
Carbon, impervious	110	1,800	10,500	4,400	2.8×10^6	....	0.30×10^{-4}	3
Graphite, plain	105	800	5,500	2,800	1.4×10^6	....	0.12×10^{-4}	85
Graphite, impervious	117	2,400	10,000	4,800	2.2×10^6	0.32	0.23×10^{-4}	85

* A.S.T.M. Method D256-43T.

Corrosion Resistance of Impervious Graphite

Chemical Reagent [1]	Max. Temp.[2]	Recommended Grade [3] Impervious Graphite	Cement [4]
Acids			
Acetic acid, all conc	Boiling	28	14
Acetic anhydride, 100%	Boiling	22	14
Arsenic acid, all conc	Boiling	28	14
Boric acid, sat	Boiling	28	14
Carbonic acid, sat	Boiling	28	14
Chromium trioxide, 10% aq. sol	200° F.	28	14
40% aq. sol	Room	21	14
40% aq. sol	200° F.	(21)	(14)
Citric acid, all conc	Boiling	28	14
Formic acid, all conc	Boiling	28	14
Hydrobromic acid, all conc	Boiling	22	14
Hydrochloric acid, all conc	Boiling	28	14
Hydrofluoric acid, under 48%	Boiling	21	14
48–60%	185° F.	21	14
over 60%		Not Recommended	
Hydrogen sulphide, sat. aq. sol	Boiling	28	14
Lactic acid, all conc	Boiling	28	14
Nitric acid, under 10%	185° F.	21	14
10–40%	140° F.	21	None
over 40%		Not Recommended	
Oleic acid, all conc	Boiling	28	14
Oxalic acid, all conc	Boiling	28	14
Phosphoric acid, under 85%	Boiling	28	14
Stearic acid, all conc	Boiling	28	14
Sulphuric acid, under 25%	Boiling	28	14
25–75%	275° F.	22	14
75–96%	176° F.	21	(14)
over 96%		Not Recommended	
Tartaric acid, all conc	Boiling	28	14
Alkalis			
Ammonium hydroxide, all conc	Boiling	21	15
Monoethanolamine, all conc	Boiling	28	15
Sodium hydroxide, under 10%	131° F.	21	15
10–67%	257° F.	21	15
67–80%	275° F.	21	15
Tetramine C, all conc	Boiling	21	15
Salt Solutions			
Ammonium thiocyanate, all conc	Boiling	22	14
Arsenic trichloride, to 100%	230° F.	28	None
Cupric chloride, all conc	Boiling	28	14
Ferric chloride, all conc	Boiling	21	14
Ferrous chloride, under 40%	Boiling	22	14
over 40%	Boiling	28	14
Ferrous sulphate, all conc	Boiling	28	14
Manganous sulphate, all conc	Boiling	28	14
Nickel chloride, all conc	Boiling	28	14
Nickel sulphate, all conc	Boiling	28	14
Phosphorus trichloride, to 100%	Boiling	28	14
Sodium chloride, all conc	Boiling	22	14
Sodium hypochlorite, under 5%	Room	21	8
Stannic chloride, all conc	Boiling	28	14
Zinc ammonium chloride, all conc	Boiling	22	8
Zinc chloride, all conc	Boiling	22	8

Chemical Reagent [1]	Max. Temp.[2]	Recommended Grade [3] Impervious Graphite	Cement [4]
Halogens, Air, Water			
Air	340° F.	28	14
Bromine, to 100%		Not Recommended	
Bromine, sat. aq. sol	Room	22	14
Chlorine, dry	Room	28	14
sat. aq. sol	Room	21	14
Iodine, 100%		Not Recommended	
Fluorine, 100%		Not Recommended	
Steam	340° F.	22	14
Water	Boiling	28	14
Organic Solvents			
Acetone, 100%	Boiling	28	14
Amyl alcohol, 100%	Boiling	28	14
Aniline, 100%	Boiling	28	None
Benzene, 100%	Boiling	28	14
Butyl alcohol, 100%	Boiling	28	14
Butyl "Cellosolve," 100%	Boiling	28	14
Carbon tetrachloride, 100%	Boiling	28	8
"Cellosolve," 100%	Boiling	28	14
Chlorethylbenzene, 100%	275° F.	28	8
Chloroform, 100%	Boiling	28	14
Dowtherm, 100%	340° F.	28	14
Dioxan, 100%	Boiling	28	14
Ethyl alcohol, 95%	Boiling	28	14
Ethylene dichloride, 100%	Boiling	28	14
Ethyl mercaptan, sat. aq. sol	Boiling	28	14
Freons 11 and 12, 100%	Room	28	14
Gasoline, 100%	Boiling	22	14
Glycerin, 100%	340° F.	21	14
Hydrazine hydrate, 85%	257° F.	28	8
Isopropyl acetate, 100%	Boiling	28	14
Isopropyl alcohol, 100%	Boiling	28	14
Isopropyl ether, 100%	Boiling	28	14
Kerosene, 100%	Boiling	22	14
Mannitol, all conc	Boiling	28	14
Methyl isobutyl ketone, 100%	Boiling	28	14
Methyl alcohol, 100%	Boiling	28	14
Monochlor benzene, 100%	Boiling	28	8
Octyl alcohol, 100%	Boiling	28	14
Paradichlorbenzene, 100%	Boiling	28	8
Paraldehyde, 100%	Boiling	28	14
Tetrachlorethane, symmetrical, 100%	Boiling	28	8
Trichlorethylene, 100%	Boiling	28	8

[1] Satisfactory use of impervious graphite is not limited to the chemical reagents listed. [2] The recommended maximum operating temperature of No. 28 material is 250 deg. F. Where boiling points exceed this, substitution of No. 22 grade is ordinarily satisfactory. Fluids above the maximum recommended temperatures may be handled if sufficient cooling is provided to maintain a safe stock temperature. [3] Recommendations in parentheses should be used with caution. [4] In general, for field use, substitute No. 15 cement for No. 8.

prevent metallic contamination of NaOH. Important in the production of high purity caustic soda for the rayon industry. Designed for a maximum temperature of 300 deg. F. on the tube side.

Thermal Conductivity of Various Materials

	B.t.u./(Hr.)(Sq. Ft.)(Deg. F./Ft.)	
Copper	224	at 32° F.
Aluminum	75–131	at room temp.
Brass, red	93	at room temp.
Impervious graphite:		
½–2 in. I.D.	85	at 200° F.
over 2 in. I.D.	75	at 200° F.
Admiralty	65	at room temp.
Tantalum	32	at room temp.
High-silicon cast iron	31	at room temp.
Steel, 1 percent carbon	26	at 64° F.
Chemical lead	20	at 32–212° F.
Antimonial lead	17–20	at 32–212° F.
Stainless steel, 18-8	7.3–17	at 32–212° F.
Impervious carbon	3	at 100° F.
Borosilicate glass	0.63	at 86–167° F.
Chemical stoneware	0.83	
Fireclay brick	0.6–0.74	at 932° F.

Chlorinated Alcohol—Coolers and condensers used to overcome the problem of unreacted chlorine present in combination with HCl formed during organic chlorinations.

Chlorinated Hydrocarbons—Coolers, condensers, and cooler-condensers used to withstand unreacted chlorine present in combination with HCl. Impervious graphite is immune to nearly all organic solvents.

Hydrochloric Acid—Coolers, condensers, absorbers and boilers. Surfaces of this material are immune to the action of HCl in all concentrations and at all temperatures up to 338 deg. F., and entire hydrogen chloride plants including gas coolers, absorbers, boilers, stripping towers, piping, pumps and valves are now constructed of it. Several improved designs for absorption systems also have been developed and are in wide use.

Hydrochloric Acid, Acetic Acid, Alcohol and Water—Boilers and condensers. The equipment withstands these chemicals not only individually, but also in many combinations, one, for example, being composed of 15 percent hydrochloric, 15 acetic, 60 alcohol, and 10 water.

Hydrochloric Acid, Benzine and Water—Coolers and condensers. Another combination of chemicals that have no individual or combined effect on this material.

Hydrocloric Acid, Chlorine, and Water Vapor—Condensers. Has high heat transfer, handling an extremely corrosive chemical combination.

Hydrochloric Acid and Nitric Acid (Estimated 10 Percent)—Condensers. This is an extremely corrosive and oxidizing mixture. Because there is no suitable cement available to withstand this condition, packed tube construction was used.

Hydrochloric Acid, Water, Naphtha and Rosin Oil—Vacuum condensers. A carbon insulating plate was used for heat protection against a maximum temperature of 550 deg. F. on the floating tube sheet.

Lactic Acid — Condensers. Sulphuric acid also present.

Oil and Chlorinated Hydrocarbons —Coolers. Hydrochloric acid and some free chlorine were also present in the solution.

Phenol Sulphonic Acid—Coolers. Sulphuric acid also present.

Phosphoric Acid—Boilers, coolers and preheaters in operation since 1942. Phosphoric acid can be handled in concentrations up to 85 percent at boiling temperatures.

Plating Solution—Heaters and coolers. The coolers have two-pass construction. Heaters can be employed in practically any plating bath except some chromium plating conditions.

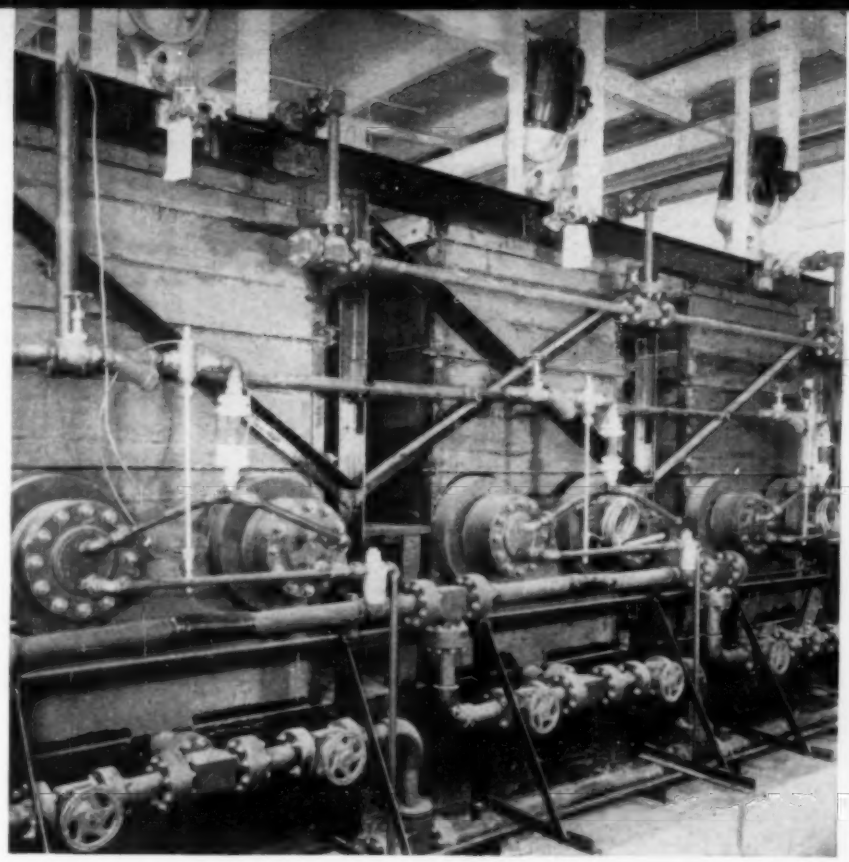
Potassium-Alum Complex Solution —Heaters. This solution is encountered in the processing of lake brines. The heaters have been in successful service for several years.

Potassium Persulphate — Heaters and coolers with shells and tubes of impervious graphite. Small amounts of sulphuric acid also were generally present.

Rayon Spin Bath—Acid heaters and many evaporators. Primarily a sulphuric acid complex solution. Obtaining satisfactory tubes, in particular, for use in spin bath evaporators and heat exchangers has long been a difficult problem. Tubes of this material have been used in a large number of such applications with a high degree of satisfaction. There have been no cases reported of such tubes being replaced by other kinds.

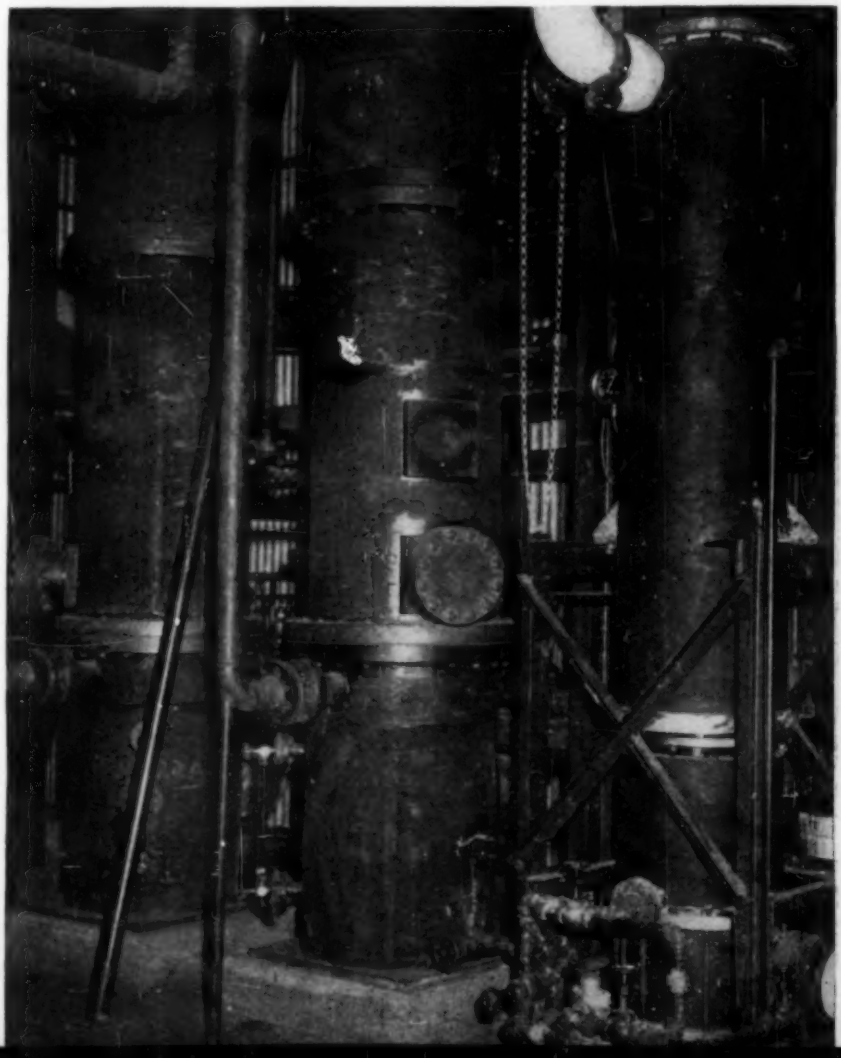
Stannous Chloride—Coolers. Some hydrochloric acid also present in the solution.

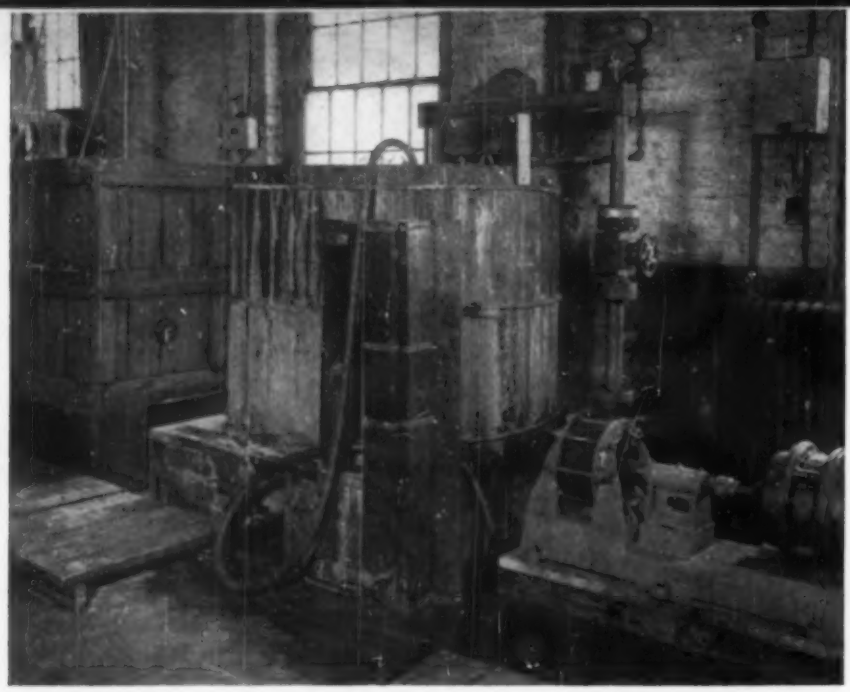
Sulphuric Acid—Coolers, evaporators and exchangers. Sulphuric acid has been handled under test conditions in concentrations up to 25 percent at atmospheric boiling temperatures, in concentrations from 1½ to 75 percent at temperatures up to 275 deg. F., and in concentrations from 75 percent to 96 percent at temperatures up to 176 deg. F. Satisfactory use is by no means limited to these temperatures under commercial operating conditions, however. In some cases reboiling for extraction of HCl and the concentration of sulphuric acid is being done at 50 percent solutions at boiling temperatures. In one particular industrial application, sulphuric acid contaminated with hydrocarbons has been concentrated from about 50 percent to



Tanks, tube bundle heat exchangers, valves, pipes, and fittings—everything in this installation except girders and steam lines—are made of impervious graphite

Heat exchanger (right) and two absorption towers of impervious graphite. External pipes, tower fittings, and exchanger tubes and tube sheets are all graphite





Impervious graphite pump, pipe, valve, fittings, and (on the left) tank

over 80 percent at temperatures approaching 300 deg. F.

Sulphuric Acid Containing Some Hydrogen Peroxide — Evaporators. Even with the effects of the strong oxidizing agent, impervious graphite gives commercial life.

Sulphuric Acid (1½ Percent)—Boilers. Sulphuric acid can be handled in concentrations up to 96 percent depending upon temperature, but special consideration must be given to the cements employed when concentrations over 75 percent are involved.

Sulphur Dioxide, Air and Water—Condensers. Corrosive sulphurous acid is formed by this combination.

Sulphuric Acid and Ethyl Alcohol—Heaters. The equipment is resistant to 100 percent concentrations of nearly all solvents and chlorinated hydrocarbons as well as to high concentrations of sulphuric acid, and will withstand combinations of these chemicals in almost any proportions.

Sulphuric Acid, Ethyl Alcohol and Ethyl Ether—Evaporators and boilers. The combination of hot corrosive solution and the necessity for rapid heat transfer make the equipment suitable for this service.

Sulphuric Acid and Beryllium Sulphate—Coolers, heaters, and forced circulation evaporators. Beryllium sulphate increases the corrosive qualities of sulphuric acid solutions. Thus the conditions entailed both severe erosion by suspended beryllium sulphate crystals and corrosion by sulphuric acid. Slurry was present in all the units. In spite of unusually severe corrosion and erosion, these tube bundles are giving a commercial life of over a year, and the tubes and tube sheets are used in conjunction with Duriron, glass-lined, and Haveg equipment.

Sulphuric Acid and Copper Sulphate—Heaters. The corrosive factor was supplied by dilute sulphuric acid in a copper refining process.

Sulphuric Acid (8-12 percent), Sodium Sulphate (18-24 Percent)—Heaters.

Thionyl Chloride—Vacuum-condensers.

Tin Plating Solution—Coolers for a continuous electrolytic plating process have been installed both here and abroad and have given successful service.

Toluol and Hydrochloric Acid Vapors—Condensing on the shell side. These units were originally constructed with nickel-clad shells, but were later converted to impervious graphite shells.

Physical Properties

It will be noted from the above that impervious graphite is a highly adaptable material of construction which has the property of high thermal conductivity and at the same time is either inert or will give longer life than most other existing materials for all concentrations of hydrochloric acid and nearly all concentrations of hot sulphuric, phosphoric, and acetic acids, wet chlorine and the organic solvents.

In the evolution of impervious graphite process equipment, the most important engineering problem has been the development of designs that would meet the strength requirments imposed by the majority of chemical process operations. The trend has been to strike a balance between available tolerances and the properties required for rugged construction against high heat transfer performance characteristics. Therefore, it is important that the designer have an appreciation of both the advantages and the limiting physical properties of the material, for the experience gained in assembling hundreds of such tube bundles in metal shells has shown that proper design and accurate fabrication of parts are absolutely necessary.

Mechanically, impervious graphite may be compared with gray cast iron in its general characteristics. The material is much stronger in compressive strength than in tensile strength and there is practically no elongation under tension. The stock is neither malleable nor ductile. The low modulus of elasticity shows that the stock bends fairly easily, but it will not bend far without breaking; therefore, equipment fabricated from it must be lined up to fit without any resort to bending or springing of the various parts into place.

The maximum safe steam working pressure for both tube and shell sides is normally placed at 50 psi. gage and the hydrostatic working pressure at 75 psi. gage. Obviously the safety factors at these recommended maximum operating pressures vary greatly with pipe size. Test pressures are normally limited to 110-115 psi. gage, although special designs can be made for higher pressures. The unit longitudinal tension in the tubes should be limited so as not to exceed 300 psi. under the specified test pressure for the shell side of the exchanger.

Most grades can now be safely operated at temperatures up to 240 deg. F., some up to 338 deg. F. Application of still higher temperatures to one side of the pipe is permissible if provision is made to carry off the heat from the opposite surface at a rate which keeps the temperature in the body of the material below the critical point. For example, exchangers can be used to cool products of hot combustibles such as those from natural, manufactured, coke or producer gas, but only when the impervious graphite parts of the exchanger are completely immersed in the cooling solution. Gas temperatures may exceed 2,000 deg. F., but only when the rate of heat transfer between the conducting materials and the cooling medium is so much higher than the heat transfer rate between the gas and the exchanger that the material will remain within its recommended operating temperature.

Shells, baffles, domes, tie rods, and other appurtenances have been developed for those applications in which it is desirable to handle corrosive fluids on the shell side of the exchanger.

Technical Writing

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For those engineers to whom writing is a troublesome chore, **Chem. & Met.,** ***in June 1946 outlined the steps in producing reports and manuscripts. Now some important details are further emphasized.***

As THEY progress in the industries of their choice, young chemists and chemical engineers become increasingly aware of the desirability of preparing well written reports as well as technical and scientific articles. It is the purpose of this paper to present a number of suggestions which are neither new nor complete but which have been often disregarded by many whose laboratory technique, engineering skill, and plant practice are accepted without question.

Competent technical writing requires brilliance no more than it necessitates genius, for anyone with adequate technological skill can turn out satisfactory copy if his schedule permits him to spend long but profitable hours in reading and in practice writing. Freed from academic confinement, recent graduates in chemistry and chemical engineering can make no better use of their spare time than to spend it in reading and in regular stints of writing.

The ability to write from first-hand observation will stand many technical men in better stead than experience in the field of the subject, although the latter is also important. An open mind and a firm resolution not to be swayed by prejudice and preconception are prime essentials to good writing. Common sense will enable the technical writer to evaluate the need for his exposition, to select his material with care, and to write with definite readers in mind. He will ask himself at the very start, "Who will read what I write? What are their backgrounds and what are their interests? How technical may I safely become? Must I define and explain constantly or can I assume the reader is familiar with fundamentals?"

Use Flexible Outlines

Most of those who write technical exposition with clarity use more flexible outlines than those emphasized by academic training. The best kind of outline is one which organizes itself from file cards on which professional writers often record their data. It is easy to collect a surprising amount of information on 4 x 6 in., or even on 3 x 5 in. ruled cards. The top line is reserved for classifying the data; at the left appears the name of the project, in the center is a main heading, and at the right is a subheading. Thus, one who is planning to write on the commercial utilization of waste sulphite liquor might head one of his cards as follows:

Waste sulphite liquor	Tanning extract	Evaporation

This would remind him later that this card contained data on the evaporation of waste sulphite liquor as one stage in the manufacture of tanning extract. When a number of such cards has been prepared it is very easy to sort them out and to assemble them in groups under properly chosen headings. The cards themselves then constitute an exceptionally flexible and revealing outline; they can be shifted around to conform to the inevitable changes in the author's plan as he develops his subject.

After the file cards have been organized into tentative form, examine them for sequence of ideas. Are first things first? Can the effect be heightened by changing the arrangement? When time permits, put the cards away and allow the ideas to simmer a few days before beginning to write.

Topic Sentences

When starting the first draft, if no inspired opening sentence presents itself, strive for some initial phrase which will capture the reader's attention, but be careful to avoid mere flash and overstatement. Write, or dictate, the first draft steadily, concentrating on recording ideas rather than on turning out highly polished prose. If the first draft is going smoothly and easily do not stop to revise, else the flow of ideas may be broken. Double space this draft and leace ample margins for corrections.

Usefulness of topic sentences cannot be over emphasized. Every writer owes it to himself and to his readers to lead off most of his paragraphs with strong, clear, and arresting topic sentences. Such sentences present no great problem and are easy to construct when the data for the paragraph are neatly arranged on a file card. In many cases it will be found that one of the entries on the card is part or all of an ideal topic sentence. In effect, with this device, the author says, "Now look, this is what I'm going to talk about in the next few lines. If you're not interested you may skip and go on—but at your own risk." That is playing fair with busy reader.

Decide on the title of the paper after the first draft is written. Let the title be informative and keep in mind the needs of abstracters and indexers who do not always examine technical papers as thoroughly as they might. For example, a suitable title for a paper dealing largely with a nomograph for the viscosity of phosphoric acid solutions might be "Viscosity Nomograph for Phosphoric Acid Solutions" (since it stresses the alignment chart) rather than "Viscosity of Phosphoric Acid," else the paper might be indexed merely under "Phosphoric Acid" and not also under "Nomograph." A short title, with or without a sub-title, is better than a long one. How much more satisfactory is: "Beater Sizing of Rag Paper (History and Development of Products and Procedures)" than the cumbersome "History and Development of Products and Procedures for Efficient Beater Sizing of 100 Percent Rag Bond Paper," a title parallel to many frequently encountered.

Revision Important

When the first draft is completed put it away for a few days or at least overnight, before revising. If no changes seem necessary, one hasn't waited long enough, for few writers can turn out acceptable material on the first draft.

Read the final draft aloud. Is it jerky and disjointed or is it smooth and connected? Reading aloud slows the eyes to the point where they will pick up minor but embarrassing slips such as "comic sections" which once appeared for "conic sections" in a mathematical paper. Reading aloud also enables one to detect the unfortunate and accidental rhymes that might appear.

Illustrations may be photographs, line drawings, or graphs. Glossy photographs should be used and if a photomicrograph is to appear full size, the part of particular interest should be marked. Three or four curves are usually enough on the same graph though more are satisfactory if they can be separated adequately. Don't run the curves through legends or any of the symbols for the plotted points. Plan the graphs with linear reductions of one-half to one-fourth in mind.

PROGRESS IN SOLVENT RECOVERY

SOLVENT RECOVERY WITH ACTIVATED CARBON HAS GONE FAR SINCE ITS AMERICAN DEBUT SOME 20 YEARS AGO. JUST HOW FAR IS EPITOMIZED IN ITS RECORD IN WARTIME SMOKELESS POWDER PLANTS.

SOLVENT recovery is an old, old problem. It is encountered, for example, whenever there are manufacturing operations where solvents are used as the vehicle for materials like plastics, lacquer, or rubber, and where solvent is removed by evaporation to the air. Such is the case in rotogravure printing and in the manufacture of acetate rayon, moisture proof paper and fabrics, artificial leather, and many other products. The problem in each case is to recover the solvent vapor from the air so that it can be reused in the process.

Prior to World War I industry had at its disposal two methods for effecting solvent recovery. Solvent vapor could be condensed directly from air-vapor mixtures by cooling below the vapor dewpoint. Or the vapor could be absorbed from the air by contacting the air-vapor mixture with oil or water, ultimate recovery of the solvent to be accomplished by distilling the oil or water. Both of these systems had the serious shortcoming of being impractical unless the air-vapor mixture was fairly rich—frequently dangerously so—in solvent vapor.

Then, between Wars I and II, a newcomer appeared on the scene, the activated carbon system. It is based on the ability of activated carbon to adsorb practically any organic solvent at about 100 deg. F., and release it when heated to the neighborhood of 250 deg. F. In practice, this principle is applied by passing vapor-laden air through a bed of activated carbon contained in an adsorber. When the carbon has retained its fill of solvent vapor, the air is diverted to another adsorber, and the adsorbed solvent is swept out of the charged bed in a stream of low-pressure steam. The mixture of steam and solvent vapor is then condensed, water insoluble solvents being recovered by simple decantation, soluble types by distillation. (Flowsheet page 136.)

During the thirties this system made material inroads into the field of solvent recovery. Chief among the advantages it brought were its ability to recover practically all types of solvent, with high over-all efficiency, and from air-vapor mixtures much too dilute for either of the older systems. Throughout the period of its development by Carbide and Carbon Chemicals Corp. the "Columbia" activated carbon system was constantly improved, both in the effectiveness of the carbon and the efficiency of the equipment which utilized it. By 1935 it was possible to install systems whose operation and control were completely automatic. Today, automatic control and operation are standard practice, thus making possible the efficient and economical operation of very large plants. As to the carbon itself, continuing improvements were made in adsorptive capacity under operating conditions and in physical and chemical characteristics. By 1940 the activated carbon system was the one most widely used for recovery of solvents of all types.

Good Shape

By 1940, too, the solution to another problem, long the subject of research had been brought to the point of commercial presentability. One of the important operating expenses in an activated carbon system is the cost of power for driving the blowers used to force vapor-laden air through the carbon bed. Although the early granular carbon particles were carefully screened to size, their heterogeneous shapes cause much greater air resistance than would a bed whose particles were all of one size and shape. It was known that such uniformity could be achieved by producing the carbon in the form of small cylinders of uniform diameter and length. However, in the past the extruded carbon produced had the undesirable characteristic of being unable to function efficiently in the presence of moisture—and not only does practically every industrial atmosphere contain moisture, but "steaming out" is an integral part of the recovery process. Plainly, if the extruded carbon was to be generally acceptable and if long drying out periods were to be avoided in the recovery cycle, this disadvantage would have to be overcome. By the end of the thirties it was overcome to industrial satisfaction and extruded carbon which would tolerate the presence of moisture was introduced commercially. The significance of this forward step lies in the fact that a bed of extruded carbon offers only about half the air resistance of the older granular product. The benefits of lower resistance to air flow may be realized in any of several ways: Power loss in forcing the air through the adsorbers could be cut by about 40 percent, air volume remaining constant; smaller adsorbers could be used; air volume through a given adsorber could be increased 50 percent or more; or, much more dilute mixtures could be processed profitably.

The last of these potentialities was of tremendous importance during the war in connection with the recovery of alcohol and ether from our smokeless powder plants. In the manufacture of powder, the solvent used is a mixture of ether and alcohol. If, as is common practice, the solvent mixture is considered in terms of its "alcohol equivalent" (1 lb. ether equivalent to 1.33 lb. alcohol), approximately 0.8 to 1.2 lb. of alcohol goes into the making of 1 lb. of powder depending

upon granulation and other factors. About half of this evaporates inadvertently during processing operations —macerating, mixing, and extrusion and cutting—and the other half is removed and recovered in a carefully controlled drying operation. During War I the solvent that evaporated into the rooms during processing was allowed to escape to the atmosphere, for it could not (and still cannot) be collected in concentrations high enough to permit recovery by either of the then existing systems.

Into the Breach

In War II, thanks to the activated carbon method of recovery and, in particular, to the special extruded carbon, it was possible to recover 98 percent or more of the solvent in the air exhausted from processing buildings, thereby plugging a leak that would have drained very considerable quantities of alcohol from our solvent hungry war program. Activated carbon recovered from 25 to 65 percent of the solvent used depending upon granulation of the powder, the majority of the remaining solvent being recovered by condensation from the drying operations. According to an Army Ordnance report (Lt. Col. H. T. Bodman, Army Ordnance Report No. 4, March 15, 1944) the net consumption of alcohol per 100 lb. of powder was reduced from 7.02 gal. to 1.94 gal. after the recovery plants were placed in operation.

Before the development of the special extruded carbon it was not generally considered practical to attempt recovery unless the vapor concentration was at least 30 percent of the lower explosive limit, or about 1 lb. of solvent per thousand cu. ft. of air. Air exhausted from powder manufacturing operations contained only about one third that amount, or an average of 0.35 lb. of solvent per thousand cu. ft. Moreover, it had to be processed in extraordinarily large volumes. If it had been necessary to design solvent recovery units for powder plants on the basis of air flow rates possible with the old crushed-and-screened carbon, the units would have been of such size and complexity as to be outside practical engineering limits. On the basis of the increased flow rates permitted by the new extruded carbon it was possible to design units which, while larger, were as simple and straightforward as those serving industry on normal concentrations.

In the Government's ten smokeless powder plants there were installed 23 activated carbon units, all designed and supplied by Carbide and Carbon Chemicals Corp. They had the astounding total capacity to handle 1,600,000 cu. ft. of vapor-laden air per min. and to recover solvent at the rate of 50,000 lbs. per hr. The above Army Ordnance report states that in one year, 1943, some 50 million gal. of alcohol were saved. At the 1943 price of alcohol, the recovery in that year alone saved about $41 million. Even more significant than the dollar value is the fact that the amount of recovered alcohol was about equal to 40 percent of the year's requirements for the synthetic rubber program and 11-12 percent of the total 1943 consumption. Conservation of such proportions, and of a material as critical as alcohol was, ought not pass unnoticed.

Since, in addition to saving alcohol, these powder plant installations established a new low in the vapor concentration required for economic recovery, it will be interesting to note something of their operating economics. Utility requirements for the recovery plants (exclusive of distillation) were as follows:

Low Pressure Steam — Approximately 3½ lb. per lb. of recovered solvent.

Water—From 7-15 gal. per lb. of recovered solvent, depending on water temperature.

Power—From 0.1-0.3 kwh. per lb. of recovered solvent. (Compares with about 0.05 kwh. for more normal concentrations, i.e., 1-2 lb. of solvent vapor per thousand cu. ft. of air)

Labor—All control and operation was automatic, thus requiring only one full time operator to record data and act as watchman.

(The utility and labor requirements for operation of the distillation equipment were in addition to the figures given above)

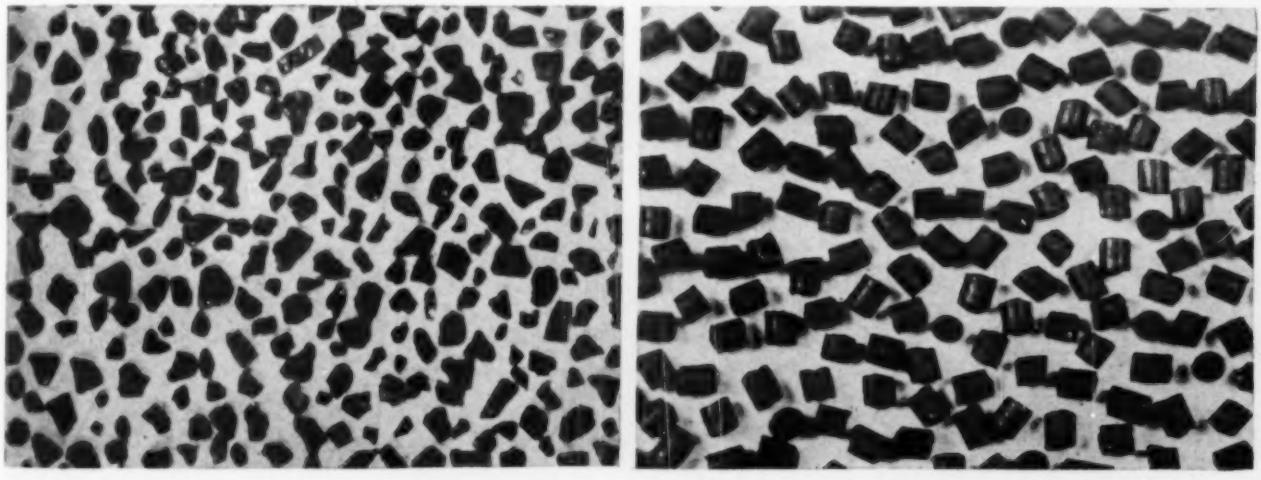
Amortization—The average plant paid for itself in less than six months of continuous operation.

Finally

From a consideration of these developments in the production of smokeless powder, industry in general can learn some profitable lessons. It has been established that it is economically feasible to recover solvents from air in which the solvent vapor concentration is extremely low. This development can be especially helpful wherever solvent vapors can be collected only in low concentrations, and where solvent costs represent an important part of the cost of the finished product.

In acknowledgement, *Chemical Engineering* expresses appreciation to Carbide and Carbon Chemicals Corp. for the data on which this article is based and for the photographs appearing on the cover and on the pictured flowsheet on page 136.

Two forms of "Columbia" activated carbon, granular (left) and extruded. Particles are actual size



HYDROCHLORIC ACID ELECTROLYSIS

W. C. GARDINER

Chemical Engineer, Mathieson Alkali Works, Niagara Falls, N. Y.

AMERICAN INVESTIGATOR REPORTS ON GERMAN CELL FOR RECOVERY OF CHLORINE FROM BYPRODUCT HYDROCHLORIC ACID AT WOLFEN

MEMBERS of the U. S. Chlorine Industry team (R. A. Horst, Solvey Process Co., E. H. Kerr, Pennsylvania Salt Manufacturing Co., A. D. Tucker, Wyandotte Chemical Co. and the author) investigated an I. G. Farbenindustrie electrolytic process for the recovery of chlorine from byproduct hydrochloric acid at Wolfen in May 1946. The Germans were developing two processes at different plants for recovering chlorine from HCl, a modified Deacon process and the electrolytic process described here. Depending on local conditions, the electrolytic process is probably the cheaper up to about 20 tons per day.

The cell had been developed at Bitterfeld and then moved to Wolfen where it had been recovering about a ton of chlorine per day for at least 14 months. It was a series type cell with bipolar graphite electrodes built like a filter press. It had 30 units, each unit operating at about 2.3 volts at 1,000 amperes. A novel feature of the cell was that broken pieces of scrap graphite actually formed the anode and were gradually consumed but readily replenished. The Wolfen cell had a total voltage of about 70 volts but the construction was such that it could be built for higher voltages. It had been operated up to 1,500 amperes.

Concentrated acid from an absorber was circulated through the cell and removed as approximately 10 percent acid which was returned to the absorber for resaturation.

Cell Construction

Essentially the cell consisted of an anodic end section, a cathodic end section, intermediate section plus supporting and clamping equipment. The concentrated hydrochloric acid entered at the bottom on one side of the anodic end section and was distributed by a canal formed by holes in adjoining sections. Near the top, similar canals served to draw off chlorine on one side and hydrogen and hydrochloric acid on the other.

Each intermediate section or unit cell had an outer frame of insulating material into which graphite slabs were cemented. The graphite was smooth on the anodic side and ribbed on the cathodic side. A polyvinyl chloride cloth diaphragm was cemented across one face of the frame, touching the cathodic graphite ribs. The space between the anode of one section and the diaphragm of another was filled with scrap graphite, about 15 mm. size. The graphite and the diaphragm were impregnated above the liquid level with a polyvinyl chloride lacquer to prevent diffusion and mixing of the liberated gases. A gasket of soft polyvinyl chloride with perforations for the various canals was used between frames.

The frames for the end sections were thicker. The canals were closed on the end but opened to the side for pipe connections. Graphite blocks with ribs were cemented into the cathodic end section and also the diaphragm while the anodic end section had plain graphite slabs with a cavity for the broken graphite and filling holes on the top side.

Electrical connections were made to each end piece by 10 round copper rods 50 mm. diameter x 145 mm. long screwed into the graphite 70 mm. The contact holes were probably impregnated with linseed oil.

The press for clamping the sections together rested on two rubber covered 4-inch I-beams supported on porcelain insulators. The cell was surrounded by a curb and the floor and curb were coated with an acid resistant cement.

Operation

When operating the cell with 32 percent acid in the feed and 10 percent acid out, the voltage was 2.3 volts per unit at 1,000 amperes and the current efficiency was 92 to 94 percent. The

Many chemical engineers in the United States will be interested in what the Germans were doing to recover chlorine from hydrochloric acid obtained as a byproduct from organic chloride manufacturing processes. During the War they were developing two processes, one, a modified Deacon process and, two, an electrolytic process. Dr. Gardiner and his associates report the results of their investigation of the latter process.

cell temperature was about 80 deg. C. The acid flowed into the anode compartment, up through the broken graphite and then through the diaphragm into the cathode compartment and out. Some dissolved chlorine is thus carried into the cathode compartment to account for some of the inefficiency while current leakage represents the rest.

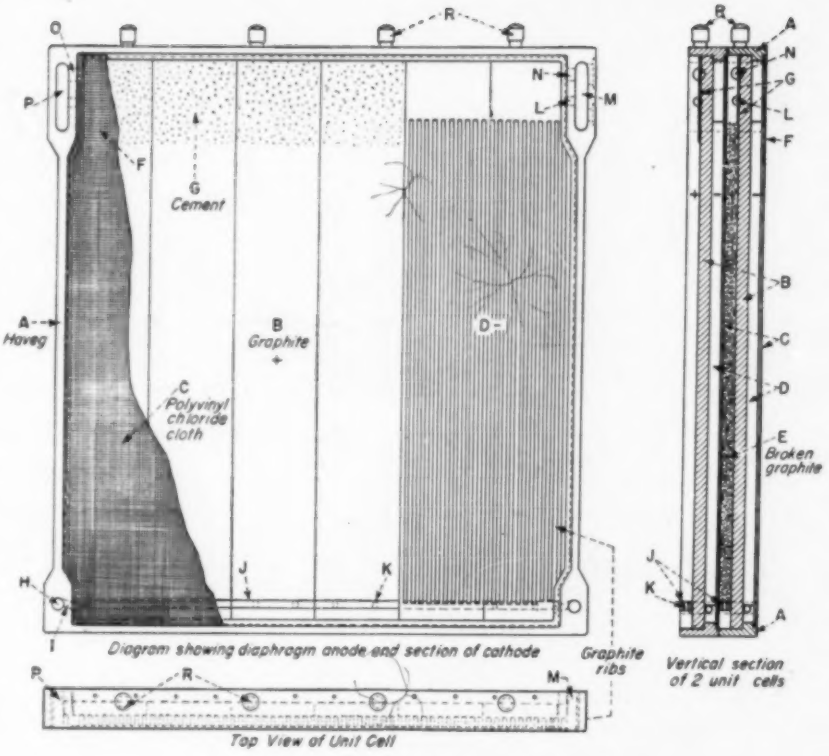
Both the Cl_2 and H_2 were scrubbed with water to remove HCl. After washing, the anode gas was 99.9 percent $Cl_2 + CO_2$ of which 0.2 to 0.4 percent was CO_2.

The broken graphite is consumed whereas there is no attack on the graphite plates. Every three months more graphite was added through the holes in the top of each frame. The fine graphite was normally consumed but under certain circumstances, such as low acid concentration, an excess of fines was formed, which caused a bridging effect at the top of the compartment. Some means of periodically flushing out the fines would be desirable but had not been developed. The consumption of graphite was 0.9 lb. per ton of chlorine. Scrap graphite from Billiter cell anodes was used.

After 14 months of operation the diaphragm was as good as new. The Haveg frames showed some spelling and efflorescence but would be satisfactory for a long time. However, the operators thought that rubber covered steel would be better. Organic and sulphur compounds were present in the hydrochloric acid but apparently gave little trouble. It was thought that it might be necessary to treat the acid with activated carbon in some cases.

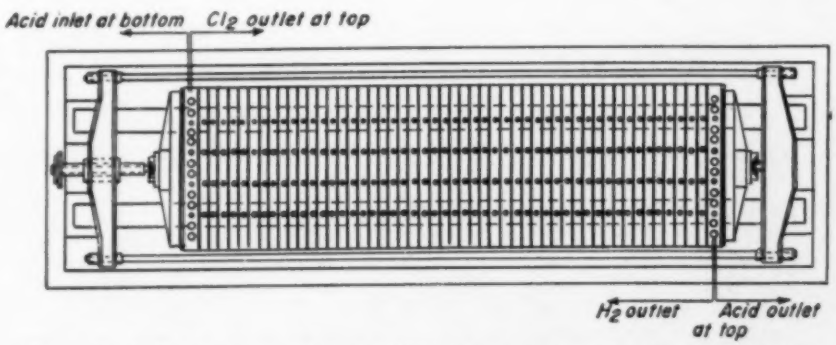
The production cost was estimated by the Germans as follows, assuming the Reichmark = $0.40.

	Cost per Ton Cl_2 gas
HCl in solution	
Electricity, 1,790 kwh. (d.c.) at $.005	$8.96
Electricity, mechanical	0.18
Operating labor and salaries incl. overhead	1.46
Repairs	2.56
Scrap graphite, 9 lb. at $.05	0.05
Diaphragm replacement, 3 yr. life	0.54
Amortization	2.90
Taxes	0.91
	$17.56
Credit for 10,000 cu. ft. H_2	.....



Several views of hydrochloric acid cell units

A — Outer frame of Haveg, rubber covered steel or impregnated graphite.
B — Graphite slabs cemented together into frame *A*. Slabs were smooth on anodic side and ribbed on cathodic side (*D*).
C — Polyvinyl chloride cloth diaphragm cemented into frame *A*.
D — Ribbed graphite on cathodic side.
E — Broken scrap graphite 15 mm. in size or smaller.
F — Layer of polyvinyl chloride lacquer making top portion of diaphragm impervious.
G — Layer of Bakelite cement on the graphite making it impervious.
H — Canal for distributing concentrated HCl.
I — Hole connecting canal, *H*, to anodic side of unit.
J — A perforated horizontal bar on the anodic side to support the graphite pieces, *E*.
K — Holes 10 mm. diameter for distributing concentrated HCl in the anodic section.
L — Outlet hole for dilute HCl from the cathodic section into canal *M*.
M — Canal for withdrawal of dilute HCl and H_2.
N — Hole for escape of H_2 from cathodic section into canal *M*.
O — Hole for escape of Cl_2 from anodic section into canal *P*.
P — Canal for withdrawal of Cl_2.
R — Stoppered openings for introducing broken graphite.



The cell, similar in construction to a filter press, contains 30 unit cells in series

[Orders for the report (Hydrochloric Acid Electrolysis at Wolfen; PB-33219; photostat, $1; microfilm, $1; 12 pages, including drawings) should be addressed to the Office of Technical Services, Department of Commerce, Washington 25, D. C., and should be accompanied by check or money order payable to the Treasurer of the United States.

More detailed information—a flowsheet, a laboratory report, and engineering drawings of plant layout and cell design—is given in a set of blueprints on sale by Chemical Alliance, Inc., 608 Woodward Building, Washington 6, D. C. The set also includes drawings of two types of vertical chlorine cells, two 7-meter and one 14-meter horizontal chlorine cells, a 2,000-amp. fluorine cell, and three types of sodium cells. The price of the set is $40, express prepaid, and orders should be accompanied by check or money order, made payable to "Warren N. Watson, Chemical Alliance, Inc."

A list of reports dealing with German-designed cells for the commercial production of chlorine may be obtained upon request from the Reference Service Section, Office of Technical Services, Department of Commerce, Washington 25, D. C.—Editors]

70 tons of bombs exploded removing one of the 1,000 magazines at this ammunition storage depot and killing six people

DEATH ON THE DESERT

CAUSES OF ACCIDENTAL EXPLOSIONS IN PROCESS INDUSTRY PLANTS CAN BE DETERMINED FROM A STUDY OF RESULTING MISSILES

CROSBY FIELD
Colonel, Ordnance Department Reserves, USA

The novelty in procedure advocated by the author lies primarily in completeness of investigation of all missiles, including one or more missile maps and delineation thereon of probable trajectories of most important missiles. From among a score of military explosions during the last war investigated by Colonel Field, a few have been selectea, one appears here, others will follow in early issues. These are typical of widely different conditions. They are given in brief form; only a few of the numerous charts and work papers necessary for the solution of each case are included.

THE GREAT American desert extends north in the United States. As it nears the Canadian border the elevation rises until the altitude is 5,000 ft. above sea level. In a most desolate part of this northern extension of the desert the government established an ammunition storage depot and placed 1,000 magazines of the igloo type.

One night in early spring while the weather was still cold two trucks were standing outside the open door of one of these igloos. One truck was loaded with bombs. This igloo faced due north and the truck loaded with bombs was close to the open door and it too faced due north. The other truck, called a crew truck, was facing northeast by east. It carried roller conveyor belts and similar accessories. It was also the truck in which the crew travelled to and from the igloos. This truck was a Ford and the van carrying the ammunition was an International.

The procedure was to have a fork lift truck inside the igloo advance through the door and projecting forks underneath the bombs in the truck, raise two bombs then back while turning so as to present its forks to the rear of the igloo. It then approached the pile already made in the rear of the igloo and raised its forks the required amount, placing its bombs on top of the pile. Two men were there to help guide the bomb.

There were six people in the vicinity. Inside the igloo were four persons: one man driving the fork lift; two men on top of the pile guiding the bombs; and the fourth man preparing dunnage and placing it on the pile before the bombs were placed. Outside and just at the door of the igloo was the van driver whose job it was to assist in guiding bombs onto forks of the lift truck as it loaded, and a young woman who normally worked on a loading dock some distance away but on the same crew. They were ahead of their schedule work and as the night was cold she had remained in the crew truck seat apparently to keep warm.

At about 9:30 p.m. there was a single sudden explosion. There were no surviving witnesses within three-quarters of a mile of the igloo. Those to the north saw a very intense and vivid white flash, described by witnesses as "like a flash of heat light-

ning," spreading in a horizontal direction due north of the igloo followed within the second by a red glow rising from the igloo which spread to a height of several hundred feet and then gradually decreased in size and disappeared. The red glow was compared by one of the witnesses to the appearance of glowing coals inside a coal fire. For a brief instant, near its beginning, it was accompanied by either smoke or dust. After the disappearance of the red glow there was no further visual sign of the explosion. The total time involved was less than one minute.

The above phenomena were witnessed by approximately a score of people at different places in the area at the time of the explosion. On all essential facts there was complete agreement. Their estimate of time was remarkable in that calculations indicate the time intervals they gave between the time of visual perception and hearing or feeling the resultant concussion check out very closely with the theoretical time intervals.

Witnesses Reported....

One witness stated that the main explosion resembled the setting off of a deep mine shaft blast. He had had experience in mining and a similar description was given by other witnesses. Many of the witnesses a mile or so away heard nothing but realized there was an explosion from the feel of the ground or the truck in which they were riding. One witness received an impulse in the ear which "started to ache" from it, but felt little jar.

All witnesses north of the explosion saw this vivid white "lightning" flash. No witnesses to the south saw this flash, but saw only the red glow. After this one explosion and the red glow from it had disappeared all was quiet. The wind blew, the tumbleweed rolled, and those who approached the scene found only the cracked concrete floor. A thorough study, of course, was made and thanks to prompt action by the Army's commanding officer present not a thing was disturbed until the arrival of the investigators. After the first vain search for survivors a few pieces of body were picked up and preserved and the investigation procedure began to grind out its results.

As usual, missile maps were made and in this particular case were accomplished at reasonable cost by having a group of laborers march up and down the vicinity placing stakes where any object was found. Then followed a surveying party of three comprising a rod man, a recorder and an expert on automotive parts. A surveyor with a transit was placed on top of one of the igloos and by stadia measurements missile locations were determined.

As the investigation proceeded it became apparent that the fork lift truck was very near the explosion. All parts of this truck that could be recovered were taken into a warehouse and were studied. Of these various parts the most informative were the back plate pieces and the two parts of the mechanism shown.

For the two holes to have been made in the two fragments by the same missile as appeared likely, they would have had to be in the position shown in the photograph. That these pieces were in such a position at the time of the explosion was further confirmed by the fact that the pieces of equipment behind the cross piece part that were covered or protected by it showed no signs of flash burning, whereas those parts which were not so protected showed signs of burning.

If these parts were in the position shown, then the position of the fork lift at the moment of the explosion was as shown. This height was just the height it would have been at had it been placing in position the last bomb on the truck.

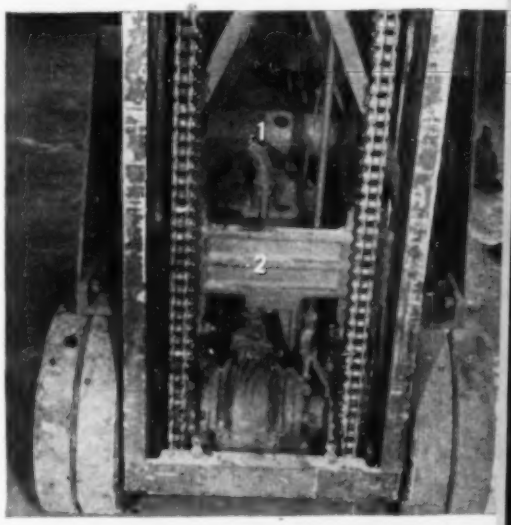
This statement is made because it is known that a typical loading diagram was followed. There were no bombs found nor was there a crater under the van at the door. It is believed therefore, that all the bombs that had been on the truck had been removed from it at the time of the explosion and the fork lift therefore was placing its last one or two bombs at the moment of the explosion.

A further study was made of the fork lift pieces as shown in the missle map. It will be noted that the dotted lines include between them all parts of the fork lift excepting the very light pieces, the trajectory of which is made uncertain by their large surfaces and light weight.

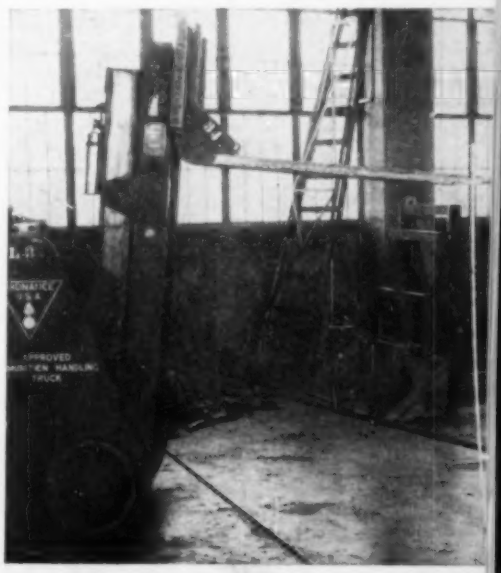
Study of Missles

A study of the other parts of the fork lift included within these two radii showed that all parts belonging to the same "family" when included by pairs of radii projected found a center within a circle formed by a 1 ft. radius with the intersection of the two dotted lines in the missile chart. This intersection therefore is the approximate point of origin of the trajectories of the fork lift parts, and the radial line from this point to any missile fragment is the horizontal projection of that trajectory.

For the two holes in back plate pieces of lift truck to have been made by the same missile as appeared likely, they would have had to be in positions shown below



If these parts were in positions shown above, then the position of fork lift at moment of explosion was as shown below



This center was 20 ft. to the north of the rear of the igloo and 8 ft. east of the west wall. This is exactly the position in which the fork lift would have been had it been placing the last bombs from the truck on the pile according to the standard loading diagram.

No parts of the bodies of any of the four persons inside the igloo were ever recovered. The parts of the man's body found when analyzed in the same fashion as for other missiles show that he was at the tail board of the van at the moment of the explosion, possibly raising the board preparatory to leaving. Similarly, the parts of the girl's body by their appearance and location show that she was seated or slumping in the seat of the Ford truck.

Colored photographs were taken at night of a detonation of a small amount of Composition B. These indicate that at the moment of explosion there is an intense white light followed by a red flash. The white flash noted by the witnesses was undoubtedly intensified by the molten metal of the bombs that were propelled through the air at a high rate of speed. Calculations indicate that the initial speed of these fragments was between 8,000 and 10,000 ft. per sec. The fact that no other white flash was seen substantiates the fact that there was one explosion. It is noted further that the reason only those persons to the north of the igloo saw the white flash was because the explosion occurred within the igloo and was therefore screened by the side and roof of the igloo from observers in any other direction, whereas the open door of the igloo was on the north side.

All of the 70 tons of bombs exploded. Of the 35 tons of Composition B explosive there was not a bit found unburned. A very small amount of the 35 tons of metal in the bombs was found.

An interesting attribute of this explosion was the extreme heat generated. Practically all of the bomb fragments showed signs of intense burning and all bomb fragments were small in size as recovered, with no sharp edges. The majority of the bomb fragments apparently completely vaporized, because out of the 35 tons of metal less than one was recovered. All stones and concrete directly underneath the stack of bombs were baked to the degree that they disintegrated upon a slight tap. This disintegration extended from the edge of the remaining floor towards the front of the igloo, a distance of approximately 10 ft.

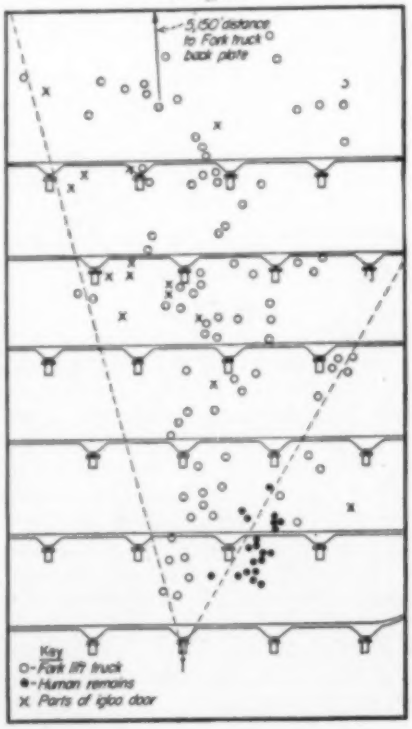
A portion of ground directly underneath the bomb stack was warm to the touch three days after the explosion to a distance of approximately 8 ft. below the floor. This was so warm that as it was being excavated smoke or vapor arose, but it is interesting to note in this respect that no hot or cold iron could be found. In the whole area underneath the crater there were recovered less than 20 lb. of bomb fragments. The only other metal recovered from the interior of the igloo, excepting reinforcing rod imbedded in the concrete, was a small piece, approximately 2 in. wide x 4 in. long, of the top of the cover of the battery compartment of the lift-truck.

Tests Were Made

In the conduct of the investigation certain tests were run. For example, at 9:30 p.m. one night, a witness who had seen the igloo explosion from the window of his home, was taken approximately the same distance and in approximately the same direction from an empty igloo, and in the empty igloo welding arcs as high as 350 amp. were drawn on steel. Witness stated that the effect was the same color as the white flash he had seen from the explosion, but very faint in comparison.

A 1,000 watt electric light was purposely broken and burned for seven seconds in the air before extinguishing itself. Next, a cable from the portable lighting plant was short-circuited by a metal plate and it was found that the light cable would burn itself up without blowing a 30 amp. fuse but would blow a 20 amp. fuse when completely shorted. As usual in an investigation of this nature, it was necessary to obtain data by tests or otherwise to disprove many hypotheses as to the cause of the explosion.

A map locating many missles of human remains, parts of trucks and door of igloo



The conclusion was that either the fork of the lift truck in moving had struck one of the bombs on its tail or what was more likely that one of the bombs being placed on the pile fell on its tail. This could easily have happened if the fork lift had moved back too suddenly after having placed the bomb on the top of the pile. It would have carried the bomb back with it and the bomb thus would have fallen approximately 5 ft. directly on its tail.

That bombs have been dropped under similar conditions was proved to have been a fact. It seemed incredible however, that after a bomb had been dropped 2,000 ft. on its nose without an explosion, that the same type of bomb dropped on its tail would explode.

Because of the definite indications from this investigation that the bomb had been dropped 5 ft. on its tail and that it had exploded, a long series of investigations were made to demonstrate that such an event could happen. As a result of this further study, modifications in the method of filling the shell with explosives were made to prevent this cause of accidental detonation.

In the meantime unfortunate accidents abroad in the handling of bombs have been reported which confirm the fact that a bomb loaded as this bomb had been could detonate when dropped on its tail from a height of even less than 5 ft.

It is known, of course, that even with this sensitivity many thousands of bombs could be dropped without any explosion. Inevitably, however, a few would sooner or later be found which would explode with most disastrous results. This is what happened not only in the igloo explosion but in several air fields and ammunition depots abroad.

Had the investigation, which led to the change in the method of loading, not followed the results of the investigation of this explosion, a great many more deaths would have occurred from the mysterious cause which undoubtedly would have gone down as one of the unsolved mysteries of the war. By taking advantage of the opportunity of studying carefully the scene of this explosion in this ammunition storage depot the cause was determined and the cure applied in time to save an untold number of lives including some of our fighting men abroad handling these bombs.

FLUIDIZATION IN CHEMICAL REACTIONS

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A METHOD IS DESCRIBED FOR DEVELOPING DESIGN DATA IN APPLICATION OF FLUIDIZING TECHNIQUES TO CHEMICAL INDUSTRY

ALTHOUGH the fluid catalytic cracking process in petroleum refining has been acclaimed for its part in producing aviation gasoline during the war, little has been said regarding the possibilities of utilizing this process in other branches of the industry. However, considerable effort has been devoted to broaden the usefulness of the fluidization process. This article discusses the application of the fluidizing technique to carrying out reactions where the solid is one of the reactants and describes some general features of the development and design of such systems.

The broad nature and advantages of fluidized systems have been sufficiently publicized[1] that they need only be touched upon briefly. Fluidization is achieved by passing a stream of gas upwardly through a bed of suitably sized particles which are thereby thrown into a state of vigorous motion similar to that of a boiling liquid. Advantages which accrue to such systems include:

Advantages of Fluidization

1. Excellent temperature control—the body of solids serves as a thermal flywheel.
2. Excellent temperatures uniformity—rapid mixing and frequent contact of the particles eliminate hot spots.
3. High heat transfer rates—of the order of those obtainable with boiling liquids.
4. High reaction rates—small particles mean increased surface for reaction which surface is kept relatively free of gas films by the sweeping action of the fluidizing gas and by frequent collisions of particles.
5. Possibility of moving large quantities of solids cheaply—amply demonstrated by present "cat crackers"; these solids can be thermophores as well as not.
6. Maintenance of a deep bed at reaction conditions—compare a nonfluid bed of solids moving slowly in countercurrent relationship to a stream of gas; there will exist a high temperature zone preceded and succeeded by lower temperature zones where completion of the reaction may not be possible.

Applications

It may be said that those processes in which fluidization is most likely to be used to advantage are the ones in which conspicuous improvement is possible by one or more of the following:

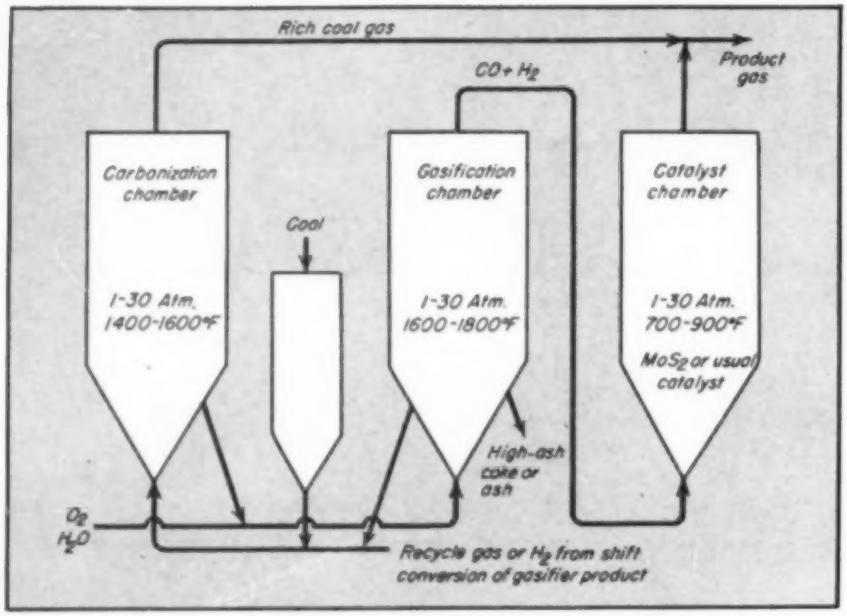
1. Improving temperature control, thereby (a) preventing undesirable side reactions, (b) preventing loss of raw materials as by sintering of residues and (c) improving quality or uniformity of product.
2. Improving heat transfer, thereby (a) increasing capacity and size of units, (b) reducing external temperature on vessel and (c) replacing external heating with thermophore.
3. Increasing reaction rates, thereby (a) Increasing capacity of units and (b) Lowering reaction temperatures.

No process has as yet been commercialized which takes full advantage of the possibilities of fluidization in carrying out a solid-gas reaction. Although it is well known that several such processes are in more or less advanced stages of development, the only development which has been publicized is work on the gasification of solid fuels by Hydrocarbon Research, Inc. and by The Institute of Gas Technology.[2] A composite flowsheet of published suggestions along this line is herein illustrated. The handling of fluidized solids has been suggested for all three vessels.

It is a practical certainty that sooner or later such a development will appear on the technical horizon. This does not deny that fluidization has its own special disadvantage or that there are possible objections to its use.

Rapid mixing in the fluid bed eliminates any significant counter current action in a single bed, requires that the entire bed have the product composition, and encourages a certain amount of short-circuiting of raw material from entrance to outlet. In certain cases this means a single fluid reactor would have to be uneconom-

Solids-gas reactions appear to be a good starting point in adapting fluidizing processes to the chemical industry. In an effort to lay a firm foundation for this work the author points out some of the major features of the process and gives basic information on development and design of fluidization process equipment.



Suggested flow diagram for fluidized coal gasification

ically large to obtain a commercially acceptable product. The cure may be the division of the fluid reactor into two or more zones between which countercurrent flow of solid and gas may or may not be enforced.

Necessity of maintaining a suitable particle size distribution in the solid during all stages of processing in the fluid bed can be troublesome. Difficulties may arise from the shattering or reduction in size of particles or from the softening of particles and consequent agglomeration. A possible precautionary measure is the circulation of a large quantity of inert material to dilute the agglomerating effect.

Design Factors

It is possible to make some preliminary generalizations with regard to design features of systems for carrying out gas-solid reactions. Both comparatively large (up to ¼ inch) and comparatively small (finer than 325 mesh) particles can be and have been successfully fluidized on the commercial scale by appropriate choice of gas velocities. However, with the larger particles certain process advantages cannot be secured. One of these is continued fluidity at low gas velocities which property makes possible the handling of solids from vessel to vessel by means of standpipes, slide valves and transfer lines (i.e., by differences in hydrostatic heads). Furthermore it is well known that in two-phase reactions the interfacial area is of prime importance in determining reaction rates. Where resistance due to films of gaseous reaction products is greatly reduced, as in fluid systems, the advantage of extended surface is felt with double force. Again, where the course of the reaction is such that the later stages must take place by diffusion of reactant and product gas through a layer of reacted solid, the merit of being able to handle fine particles is obvious.

The above considerations make it appear likely that most processes which may be developed to apply the fluid technique to gas-solid reactions will make use of particles having a maximum size of about 60 to 325 mesh depending mostly on the density of the solid and less on the viscosity and density of the gas. This corresponds to an upward linear gas velocity of about 0.5 to 2.0 feet per second. Exceptions will occur where the reaction is inherently rapid or where an incomplete reaction is acceptable for some special reason.

All of this is equivalent to having fixed the horizontal cross section of a fluid reaction vessel as mainly dependent upon the capacity of the unit in terms of gas throughput. The vertical dimension of the unit, its division into two or more zones between which rapid mixing does not take place, and the path of the solids through the system will be determined by the necessity for providing economically complete reaction of the entrant gas and solids.

It should be realized in reaching a compromise between efficiency of gas consumption and height of equipment that acceptance of a certain incompleteness of reaction in order to decrease the vertical dimension involves an accompanying increase in cross section if the same capacity in terms of net product is to be maintained. Furthermore extra expense in recovering reactant gas from the outgoing stream and recycling it to the system may be involved. On the other hand, compromises between efficiency of solids consumption and unit height are usually attended by a loss of chemical values and a lowered quality of solid product.

Flow pattern in a single fluid reaction zone or vessel is unusual in that the upwardly flowing gas stream can most reasonably be regarded as moving through the vessel in streamline fashion, not in the aerodynamic sense but meaning that mixing in the direction of flow is comparatively unimportant. On the other hand, the solids are in violent and rather erratic motion and top to bottom mixing is characteristic. It is a reasonable approximation to assume perfect (instantaneous) mixing of the solids. There will still, of course, be practical advantage in locating the solids inlet and outlet in remote parts of the vessel to discourage short-circuiting but the residence time of the solids will usually be long compared to the mixing time in the bed.

The fact that the whole of a fluid bed has substantially the outgoing analysis and the further consideration of reducing short-circuiting makes it likely that most commercial processes will use two or more stages, whether the flow of solids is concurrent or countercurrent. The stages may take the shape of separate vessels or grids or other methods of splitting the bed into zones may be used.

Types of Solid-Gas Reaction

Two principal cases of solids-gas reaction can be distinguished. The first is where one or more of the reaction products remains in the solid phase such as in the reduction of refractory metals, roasting of ores, calcination of limestone and desulphurization of gases with iron oxide. The second case is where principal reaction products are all in the gas phase such as the reduction of metals which are volatile at reaction temperature, gasification of solid fuels and the chlorination of certain ores. These two types will be referred to frequently as this discussion proceeds.

The first case is distinguished by the building up of a shell of reaction products on a core of unreacted material with consequent resistance to further

reaction. It will be natural to secure as much countercurrent action as possible; this will be the primary function of whatever separate zones are set up in the reaction vessel. The desired completion of reaction must be obtained within the fluid system. The solid products carry the same nonvolatile impurities as the raw materials entering the system.

The second type of reaction is characterized by the concentration of unreactive impurities in the solid bed, which impurities must be drawn off either intermittently or continuously. Aside from the influence of impurities, the solids, if otherwise homogenous, should not decrease greatly in reactivity; they should, in fact, be slightly more reactive because of increased specific surface as the particles are consumed. The primary function of reaction zones which may be set up in the system will be to prevent short-circuiting of solids from entrance to outlet. Flow of solids will often be concurrent with the gas stream to encourage the removal of fine particles of impurities at the top of the bed. If the impurities are only a small part of the feed stream it may be possible to take off from the unit a small stream of impurities containing a considerable amount (possibly 50 percent) of the valuable component.

Intermediate cases arise where the reaction products are all gases but the solid feed is not of uniform reactivity. The effect of the exhaustion of the more reactive material on the process arrangements would have to be determined experimentally. A number of natural raw materials, such as coal and ore containing the valuable metal in more than one mineral species, fall in this category. Other cases occur when a solid reaction product tends to break away from the original particle usually because of a large difference in density between the feed and product.

Development of Reactor Design

In calculating reactions taking place in fluid beds, the extent of consumption of the incoming phases may be treated separately, remembering, of course, that stoichiometric balances between the two must be exact. The gas phase may be considered to be in contact during its entire passage through any fluid bed or isolated zone therein with solids of the effluent composition. On the other hand the solids may be considered, as an approximation, to be in contact with gas of an average composition for the bed being considered. The average should be duly weighted for the influence of gas composition on reaction rate or should be applied to reaction rate data obtained by averaging gas composition in a standard way.

Published data will, in general, be of little use in estimating reaction rates for fluid systems except to generalize that reaction rates will be higher than indicated by prior commercial practice. Furthermore, the possibility of maintaining a comparatively large bed at reaction conditions will help in the approach to equilibrium under given reaction conditions. In every case it is advisable to conduct preliminary laboratory experiments before attempting to design even the simplest pilot unit.

First and most obvious information needed for design purposes pertains to the fluidizing properties of the solids in question, namely the particle size distribution to which the solid raw materials must be reduced to render them fluidizable, the method of grinding, and the relationship between the linear velocity of the fluidizing gas (convention ally calculated on the basis of an empty vessel) and the density of the fluid bed. These items may be affected by what happens to the particles during the course of the reaction but, in general, a powder which can be fluidized readily by air at normal conditions will behave satisfactorily at reaction conditions. However, the subject of the relationship of fluid properties to particle size, particle size distribution, particle density, particle shape, gas viscosity, gas velocity, gas density and the usual criteria of fluid flow is one on which there is practically no information available.

First, a grinding method is required, the product of which shows fluidity over a broad range of gas velocities, say 0.05 to 1.5 feet per sec. and a continuous and reasonably rapid increase in fluid density with decreasing gas velocity. The latter specification arises from the fact that the force behind the movement of solids from one vessel to another in fluid systems is the difference in density and hence in hydrostatic head between beds of solids aerated with gas at different velocities. The required particle size distribution will most often be one which can be duplicated with available commercial equipment.

Preliminary laboratory experiments to determine reduction rates will most easily be made batchwise. Continuous control of solid flow is difficult but possible on the laboratory scale and in some processes, particularly where reaction products are in the gas phase, this may be advisable. In any event behavior during a batchwise run at constant temperature and inlet gas composition will be quite different in the two cases.

Obtaining Data

Assuming a depth of fluid bed (¼ ft.) which can be conveniently obtained in the laboratory, the first stages of a reaction may or may not be marked by the attainment of equilibrium gas composition for the temperature and pressure in question. If so, the exit gas composition will remain constant for some period. As the run proceeds, however, the outgoing gas will become richer in the entrant constituents. It will be necessary to keep a continuous record of outgoing gas composition by some convenient method such as by measuring the rate of production of some readily identifiable substance (e. g. water or carbon dioxide) or by measuring the volume of the product gases where this bears a calculable relation to their composition. The outgoing gases should in any event be metered to obtain a material balance. A continuous gas analyzer may be a useful piece of equipment.

Where reaction products are in the

SOME ADVANTAGES OF FLUIDIZED SYSTEMS

1. Improved temperature control—body of solids serves as a thermal flywheel; greater temperature uniformity is due to rapid mixing which eliminates hot or cold spots.

2. High heat transfer rates—of the order of those obtained with boiling liquids.

3. High reaction rates—small particles provide increased reaction surface.

4. Provides method for moving large quantities of solids at low cost.

5. Permits maintenance of a deep bed at reaction conditions.

solid phase or the run data will be characterized by a relatively unchanged depth of bed and by a rather rapid drop in reaction rate. On the other hand where reaction products are gases the depth of bed will gradually decrease as will the degree of reaction of the outgoing gas. Decrease in gas consumption will not usually indicate a decrease in the velocity constant for the reaction after the exposure time of the gas is taken into account. Because of the decreasing bed depth, it will be particularly important to provide appropriate instrumentation for the reaction vessel. This means simply the provision of means for measuring the pressure drop across the vessel and, if possible, the density of the fluid bed.[8] Since the size of the solid particles will be decreasing it may be necessary to examine the fluidizing properties of the solids for various stages of reaction.

If the runs have been properly planned there will be furnished for each experiment a continuous record of temperature, bed depth, fluid density, inlet gas composition and flow rate, exit gas composition and flow rate or basis for calculating same, and composition of solids or basis for calculating same.

When data have been taken for a series of different temperatures and starting bed depths, it will be possible to select points from each run corresponding to solids which have been reacted to the same extent. These data can be examined for correspondance to one of the simple reaction orders. In fortunate cases where such a relation can be established there will result a formula expressing the consumption of reactant gas as a function of exposure time of the gas (bed depth) and of a velocity constant. The constant will, in turn, be a function of temperature alone for a given condition of solid reactant (solid composition and particle size). Again, in cases which are more likely to occur for solid reaction products than gaseous reaction products the variability of velocity constant with degree of reaction of solid will not be great and one relation will hold with reasonable accuracy over a considerable part of the total reaction. Failing ready classification into one of the simple orders, a purely empirical or graphical relation must be set up between gas composition and time for certain conditions of temperature and solid reactions.

The time, t_e, referred to in these expressions is, of course, the exposure time of the gas to the solids as distinct from the residence time of the solids. For a particular fluid bed $t_e = W_s/\rho_f A v_g$; W_s = weight of solids in reaction vessel, v_g = linear velocity of gas conventionally calculated as if solids were absent, ρ_f = fluid density at v_g, and A = horizontal cross-section of vessel.

Complications arise in estimating the gas velocity when the reactions taking place in the bed are accompanied by a change in volume. An arithmetic average of inlet and outlet gas volumes can be used as a starting basis, the calculations being refined, if necessary, after the reaction order has been established. Also, unless direct data are available, ρ_f will have to be estimated from aeration tests performed under different conditions.

Continuous Operation

Actually a continuously operating fluid bed consists of particles which have resided there for all conceivable periods shorter than the time since the bed came into existence. The particles therefore have been reacted to different degrees. Instantaneous data taken from batchwise experiments have a different significance when applied to the solid than when applied to the gas. In the latter case gas analyses may properly be taken as representing total reaction degree for the gas during its exposure to the then existing solids. On the other hand, the same gas data may be interpreted stoichiometrically into a rate of reaction of the solids and correlated with the then existing solids analysis and the entrant and exit analyses of the gas. Exposure time of the gas is not a factor in the latter calculation provided only that the gas has not reached its equilibrium composition during its passage through the bed and provided the apparent order of the reaction does not change with the degree of reaction of the solids.

Relationship between rate and degree of reaction may be solved by any appropriate means to yield time-degree and time-rate relationships for a given temperature and gas inlet and outlet composition. From a consideration of the reaction rate expression and given the residence distribution of the particles in the bed, it will be possible to estimate the quantity of solids (bed depth) which must be present to achieve the stated degree of reaction of the gas (actually the stoichiometrically equivalent rate of reaction of solids).

Above results may be checked by means of the residence distribution of particles and the time-degree of reaction relationship for the particles and the gas reaction relationships. The velocity constants in these last equations are then weighted for the amount of solid of each degree of reaction present. More specifically the experimentally determined time-degree of reaction relationship for the chosen inlet and outlet gas compositions is combined with the residence distribution equation for the particles to yield either a degree of reaction distribution for the particles or, by summation, an overall degree of reaction for the bed. Assuming it has been possible to obtain some form of velocity coefficient for the reaction, whether purely empirical or not, it will be possible to assign to the fluid bed an overall velocity coefficient. This coefficient applied to the gas reaction equation with the substitution of the gas exposure time corresponding to the size of fluid bed already calculated should yield a degree of gas reaction checking rather closely the assumed one. Should the time requirement not be met by a single fluid bed of commercially practical dimensions (deepest beds in current operation are about 40 feet) the need for two or more stages is indicated. All of the quantitative data corresponding to the above will be specific to a certain solid raw material and to a certain particle size thereof. Empirical relationships derived in the course of the above investigations should be kept as simple as possible because of the necessity for various cross-combinations.

Assumption is made that the feed stream of solids consists of uniformly sized particles. Such will not be the case; in fact a fluid bed with all particles of the same size would not function. Nevertheless an attempt to take into account the distribution of particle size except on an averaged basis complicates the calculations beyond practical limits.

Whether laboratory data are taken batchwise or not, limitations of equipment size will usually necessitate more or less extrapolation of the experimental results in calculating to larger sizes. In reaching decisions regarding the terminal composition of gas and solids care must be taken, of course, to avoid presumption of a thermodynamically impossible situation.

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Estimating Chemical Piping Costs

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PREPARATION of cost estimates for piping systems depends on two major factors namely, material and labor. Estimates of material cost is relatively simple and can be determined readily from data such as appears on the following page. Actually, the fob prices given are averages based on published discounts for average quantities and are revised to June 1946. In practice it is necessary to revise the cost data occasionally or to set up correction factors based on average price changes.

One of the most difficult items to estimate in chemical installations is the number of manhours required for fabrication and installation of piping. The formula herein given provides a means to determine piping labor requirements which, combined with per hour labor cost and material costs, provide a reasonable basis for preconstruction cost estimates.

Estimating the labor to install chemical piping systems is complex due to the large number of variables resulting from working conditions, types of piping materials, and the wide range of sizes. Accuracy of the method depends on correctly estimating the pipe footage, the number and types of valves and fittings, and on taking into consideration the working conditions which affect labor requirements and the materials of construction used. The formula is set up on the basis of the number of manhours required to cut, thread or ferrule, fit and erect, one length of pipe.

Application of Method

A typical example of how to estimate the amount of labor to fabricate and install a piping system will illustrate the application of this method to specific problems. A piping system is comprised of 200 lineal ft. of 2½ in. pipe, 6 valves, 22 ells, 6 tees, 12 flanges; 120 ft. of ½ in. pipe, 4 valves, 40 ells, 4 unions (miscellaneous), 4 gages (specialties). Wrought steel pipe is used with screwed and flanged fittings. Working conditions are cramped, new piping must be connected into an existing system and no fabrication is permitted on the job.

Equivalent value F of fittings for the 2½ in. system sums up to 40.0; for the ½ in. part of the system F totals 54.4. Manhours to install the 2½ in. diameter part of the system are found by substituting in Case 2 as follows: $L. = (0.15 \times 200) + 2.5\ (1.5+0.6)\ 40 = 240$ hr. Labor for the ½ in. diameter portion of the system is determined by using Case 1 as follows: $L = (0.1 \times 120) + 2.5\ (0.3 + 0.4)\ 54.4 = 107$ hr. Total labor then is 347 manhours on the basis of normal working conditions.

Special conditions must be allowed for and are (1) cramped working conditions, add 15 percent; (2) tie into existing system, add 15 percent; (3) fabricating restrictions, add 10 percent; and (4) for using wrought steel construction, deduct 15 percent. Total correction factor then is plus 25 percent. Total manhours required to fabricate and install the system is $347 + (0.25 \times 347) = 434$ hr.

FORMULA FOR ESTIMATING MANHOURS REQUIRED TO INSTALL CHEMICAL PIPING SYSTEMS

$$L = BP + A\ (0.6X + C)\ F$$

(Based on stainless steel)

L = manhours required for fabrication and installation.
A, B and C = constants, see below.
X = nominal pipe size, inches.
P = length of piping, feet.
F = equivalent value of fittings in terms of ells, see below.

VALUE OF CONSTANTS

Case 1: ½ to 2 in. dia. (incl.) screwed and flanged pipe systems: A=2.5, B=0.1, C=0.4.

Case 2: 2½ to 4 in. dia. (incl.) screwed and flanged pipe systems: A=2.5, B=0.15, C=0.6.

Case 3: ½ to 3 in. dia. (incl.) flanged and ferrule pipe systems: B=0.1, C=0.4, A=see table.

Values of F

Fittings	F
Elbows, 90 & 45 deg.	1.0
Valves, Specialties	1.3
Tees, "Y's"	1.5
Crosses	2.0
Flanges	0.1
Miscellaneous	1.0

Note: Where three or more flanged-fittings are face to face reduce F by ⅓.

Values of A, Case 3

Ferrule Pipe Dia., In.	A
½	4.14
¾	3.81
1	3.25
1½	3.15
2	2.97
2½	2.95
3	2.90

CORRECTION FACTORS

These corrections, applied to the manhours calculated by the above formula, account for special conditions affecting labor requirements.

1. New construction, or normal working conditions with few obstructions, cutting and fitting permitted at site – add 0 percent.
2. Conditions where installation requires ladder or scaffold work – add 15 percent.
3. Cramped or restricted working space – add 15 percent.
4. Where piping is connected to or tied in with an existing system – add 15 percent.
5. Conditions where cutting or threading is not permitted at the site of the work – add 10 percent.
6. Materials of construction other than stainless steel used in Cases 1 and 2: Wrought steel – subtract 15 percent; glass – add 110 percent; porcelain – add 85 percent; Saran – add 22 percent.

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PIPING PRICE DATA FOR PRECONSTRUCTION COST ESTIMATES

THESE fob prices, revised to June 1946, are averages based on published discounts for average quantities purchased. Combined with installation labor costs (see preceding page) these data will provide a basis for preconstruction piping cost estimates.

316 Stainless Steel, Flanged Fittings (Dollars Each)

Size, in.	Ells, 90 deg.	Ells, 45 deg.	Tees	Crosses	Laterals	Slip-on Flange	Ferrule with Flange
½	9.60	9.46	14.85	20.65	18.15	5.75	3.40
¾	9.60	9.46	14.85	20.65	18.15	6.90	3.64
1	10.90	10.47	16.21	21.78	19.06	8.47	4.35
1¼	11.55	11.44	17.42	23.23	20.32	9.68	5.20
1½	15.20	14.70	22.74	30.31	26.56	10.89	5.80
2	19.35	18.58	29.04	38.72	33.88	13.31	6.90
2½	24.38	23.54	36.54	48.71	42.78	15.73	7.50
3	30.49	29.34	45.74	60.98	53.24	19.36	10.00
4	43.38	42.50	65.08	86.79	75.81	30.25	
6	69.69	67.10	104.54	139.39	121.97	45.37	

Standard Pipe (Dollars per Foot)

Size, in.	S.S. 304	S.S. 316	S.S. 347	Wrought Steel	Galvanized	Nickel	Monel	Copper	Brass	Saran	Glass
¼	0.50	0.55	0.80	0.03	0.05	0.64	0.49	0.06	0.09		
⅜	0.56	0.76	0.65	0.04	0.05	0.87	0.63	0.07	0.15		
½	0.74	0.84	0.79	0.04	0.05	0.97	0.83	0.08	0.20		
¾	0.95	1.58	1.30	0.05	0.06	1.81	1.04	0.08	0.24	0.28	
1	1.34	1.86	1.58	0.06	0.07	2.13	1.41	0.12	0.29	0.39	
1¼	1.60	2.11	1.98	0.08	0.10	2.42	1.69	0.18	0.43	0.56	0.65
1½	2.11	3.54	2.85	0.11	0.11	4.07	2.21	0.27	0.57	0.62	
2	2.43	3.90	3.20	0.13	0.13	4.48	2.68	0.50	0.75	0.83	1.05
2½	2.85	4.48	3.66	0.17	0.18	5.15	3.15	0.65	1.15	1.12	1.55
3	4.19	5.65	5.23	0.24	0.28	6.49	4.69	1.02	1.46	1.72	
3½	5.49	7.80	6.95	0.38	0.40	8.97	6.14	1.34	1.85	2.32	2.10
4	6.06	8.90	7.87	0.40	0.49	10.23	9.96	1.50	2.20	2.80	
6	7.18	11.08	8.97	0.54	0.59	12.74	12.40	1.91	2.90	3.63	4.00
	10.98	21.50	13.44	1.03	1.15	24.72	24.08	2.92	4.43	6.28	

Tubing (Dollars per Foot)

Size, in.	S.S. 304	S.S. 3.6	S.S. 347	Steel	Nickel	Monel	Copper	Brass	Saran	Tygon	Neoprene
¼	0.32	0.35	0.33	0.03	0.41	0.30	0.03	0.09	0.07	0.11	0.08
⅜	0.38	0.45	0.40	0.04	0.50	0.42	0.05	0.10	0.09	0.19	0.13
½	0.43	0.54	0.49	0.06	0.61	0.53	0.07	0.13	0.14	0.23	0.20
¾	0.70	0.73	0.71	0.12	0.96	0.77	0.13	0.19	0.28	0.58	0.40
1	1.04	1.17	1.06	0.16	1.25	1.15	0.16	0.23		1.05	0.55
1¼	1.41	1.48	1.43	0.21	1.71	1.54	0.24	0.35		1.36	0.80
1½	1.56	1.81	1.70	0.25	2.12	1.72	0.26	0.79			
2	2.14	2.84	2.54	0.34	3.16	2.35	0.39	0.98			
2½	2.69	3.10	2.89	0.48	3.61	2.96	0.65	1.75			
3	3.83	3.96	3.71	0.57	4.64	4.36	1.04	2.80			
4	4.23	5.08	4.45	0.77	4.56	5.25	2.25	3.89			

Pyrex Pipe Lengths (Dollars Each)

Size, in.	6 in.	12 in.	18 in.	24 in.	36 in.	48 in.	60 in.	72 in.	96 in.	120 in.
1	2.25	2.35	2.50	2.60	2.80	3.10	3.30	3.50	4.00	4.50
1½	3.10	3.35	3.55	3.75	4.20	4.65	5.15	5.60	6.50	7.55
2	3.80	4.10	4.45	4.75	5.45	6.15	6.80	7.50	8.90	10.25
3	5.60	6.15	6.65	7.20	8.30	9.40	10.50	11.60	13.85	16.10
4		11.30	12.40	13.45	15.50	17.60	19.60	21.70	25.90	30.00

Porcelain Fittings Flanged (Dollars Each)

Size, in.	Ells, 45 deg.	Ells, 90 deg.	Tees	Flanges	Cap	Crosses	Check Valves
1	4.00	4.00	4.80	0.65		9.58	31.00
1½	4.15	4.25	5.40	0.95	2.15		33.85
2	4.60	4.86	6.40	1.25		11.04	
3	5.75	6.23	7.40	1.80	3.00	12.50	
4	8.50	8.25	14.80	2.00	7.25		

150 Lb. Forged Steel Flanged Fittings (Dollars Each)

Size, in.	Ells, 90 & 45 deg.	Tees	Reducers	Laterals	Slip-on Flange	Blind Flange
1	9.00	13.50	10.00	18.00	1.00	1.40
1¼	9.90	14.40	11.00	19.00	1.10	1.40
1½	10.20	15.30	12.00	21.00	1.20	1.40
2	11.70	17.20	13.00	23.00	1.30	1.60
2½	13.50	18.00	14.00	26.00	1.40	1.80
3	15.30	21.00	15.00	30.00	1.70	2.00
4	20.00	26.00	30.00	37.00	2.40	3.00
6	30.00	41.00	30.00	45.00	3.00	4.00

Porcelain Pipe Lengths Flanged (Dollars Each)

Size, in	6 in.	8 in.	12 in	24 in.
1	0.53	0.60	1.04	2.08
1½	0.58	0.70	1.18	2.50
2	0.60	0.85	1.30	2.60
3	1.35	1.50	1.90	3.90
4	2.40	2.90	3.00	6.90

125 Lb. Std. Cast Iron Flanged Fittings (Dollars Each)

Size, in.	Ells, 90 deg.	Ells, 45 deg.	Tees	Crosses	Laterals	Screwed Flange	Blind Flange
1	4.24	4.60	6.19	9.38		0.94	1.29
1¼	4.24	4.60	6.19	9.38		1.00	1.36
1½	4.24	4.60	6.19	9.38		1.06	1.47
2	4.24	4.60	6.19	9.38	9.38	1.18	1.65
2½	4.40	4.83	6.43	9.61	9.61	1.29	1.83
3	4.89	5.31	7.19	10.67	10.67	1.47	2.01
4	6.49	7.08	9.44	14.16	14.16	2.12	2.56
6	10.50	11.38	15.28	23.71	22.71	2.95	4.13

316 Stainless Steel Screwed Fittings (Dollars Each)

Size, in.	Ells, 90 deg.	Ells, 45 deg.	Tees	Crosses	Caps	Couplings	Plugs	Bushings	Unions
½	1.80	2.25	2.55	3.65	1.70	1.80	1.15	1.25	4.85
¾	2.10	2.75	3.00	4.25	1.95	2.05	1.35	1.45	6.40
1	2.70	3.20	3.95	5.45	2.40	2.60	1.70	1.80	8.45
1¼	3.65	4.25	5.15	7.25	3.15	3.40	2.20	2.35	11.80
1½	4.55	5.45	6.35	9.05	3.95	4.25	2.75	2.95	15.45
2	6.65	7.85	9.15	13.20	5.45	6.05	3.75	4.10	20.55
2½	13.20	15.75	18.65	26.60	9.65	10.05	5.80	9.30	27.75
3	16.95	19.95	23.70	33.90	12.45	13.90	8.85	11.35	38.55
4	22.40	25.40	31.45	47.45	17.80	19.35	13.65	17.40	56.15

150 Lb. 316 S. S. Valves (Dollars Each)

Size, in.	Globe Valves Screwed	Globe Valves Flanged	Gate Valves Screwed	Gate Valves Flanged	Swing Check Valves Screwed	Swing Check Valves Flanged
½	10.70	22.00	11.15	17.52	11.72	10.90
1	22.23	30.25	18.19	25.66	29.70	27.15
1½	35.99	41.25	27.34	36.78	36.30	38.40
2	45.45	49.50	35.79	46.10	44.04	45.38
2½	60.50	74.25		57.71	52.00	67.74
3	65.00	123.75		59.85		80.00
4				86.88		117.50

150 Lb. Brass Valves (Dollars Each)

½	2.66		2.75		2.40	6.00
¾	3.48	9.62	3.21	14.20	3.15	9.30
1	4.88	11.10	4.44	16.33	4.35	13.00
1¼	6.36	17.02	6.12	19.17	6.00	18.00
1½	8.88	20.73	7.65	23.43	8.25	24.50
2	14.06	31.08	13.24	39.76	12.00	36.00
2½	25.16	46.62	19.89	51.12	22.50	65.20
3	35.52	63.64	29.07	63.90	34.50	99.40

Pyrex Std. Fittings (Dollars Each)

Size, in.	Ells, 45 deg.	Ells, 90 deg.	Tees	Y's	U's	Reducers	Flanges (Pair)
1	3.25	3.25	3.35	4.75	3.25		0.40
1½	4.25	4.25	4.50	6.25	4.25	3.10	0.80
2	5.25	5.25	5.50	7.60	5.25	3.80	0.70
3	8.25	8.25	8.50	11.00	8.25	5.60	1.20
4	12.50	12.50	16.50		13.50	11.30	3.15

Standard Saran Fittings (Dollars Each)

Size, in.	Ells, 90 deg.	Tees	Reducers	Companion Flanges	Blind Flanges	Couplings	Caps	Plugs
½	0.88	1.05		0.95	0.95	0.35	0.35	0.13
¾	1.05	1.19	0.46	1.00	1.00	0.42	0.42	0.14
1	1.23	1.40	0.53	1.23	1.23	0.49	0.49	
1¼	1.40	1.68	0.60	1.40	1.40	0.56	0.56	
1½	1.58	1.96	0.70	1.68	1.68	0.67	0.67	
2	1.75	2.24	0.98	2.10	2.10	0.84	0.84	

125 Lb. Std. Cast Iron Fittings, Screwed (Dollars Each)

Size, in.	Ells, 90 deg.	Ells, 45 deg.	Tees	Crosses	Laterals
½	0.10	0.10	0.10	0.20	0.25
¾	0.10	0.10	0.15	0.30	0.35
1	0.15	0.15	0.20	0.35	0.40
1¼	0.20	0.25	0.30	0.50	0.70
1½	0.25	0.30	0.35	0.65	0.80
2	0.35	0.40	0.50	0.95	1.15
2½	0.60	0.75	0.90	1.60	2.05
3	0.90	1.10	1.40	2.30	3.10
4	1.50	1.80	2.20	4.05	5.00
6	3.45	4.30	5.00	9.05	11.50

1946 POWER SHOW

EDITORIAL STAFF

ALTHOUGH NATURALLY OF LESS INTEREST TO CHEMICAL ENGINEERS THAN THE CHEMICAL SHOW, THE POWER SHOW OFFERS MANY IDEAS

During the week of December 2, coincident with the meeting of the American Society of Mechanical Engineers in New York, the 17th National Power Show was held at the Grand Central Palace, in New York. From every standpoint, the show was one of the best on record, both in attendance and in the number of exhibitors which reached 386. Marking the return to the Grand Central Palace, from Madison Square Garden where the show was held during the war years, exhibitors generally devoted extra effort to the quality and appearance of their booths, as well as to interest-arousing features. As in the past a number of *Chemical Engineering* editors combed the show for developments that were new since the 16th show two years ago. Those that should interest chemical engineers are described briefly here.

Electrical

Among new electrical equipment exhibited was a line of small selenium rectifiers for electroplating and battery charging, shown by Electro-Tech Equipment Co., New York. The rectifiers operate on 110-volt, 60-cycle current to deliver a continuously variable d.c. current at from zero to 8 or zero to 12 volts, depending upon the model. Three sizes, from 25 to 150 amp. capacity, are produced. Similar equipment was exhibited by Richardson-Allen Corp., New York. Controls of these low-voltage, high-amperage rectifiers are immersed in oil to protect against acid fumes. Various sizes are available from 6 v., 25 amp. to 9 v., 2000 amp.

Several electrical developments were displayed in the booth of Russell & Stoll Co., New York. Included was a new explosion-proof overhead lighting fixture for 300 or 500 watts input, new explosion-proof and dust-proof starters up to about 25 hp., and an improved receptacle and plug of heavy-duty, explosion-proof design. This concern showed a new standardized factory-built unit alarm system to provide supervision of all types of electrical and mechanical process control in one compact unit. This company's subsidiary, Feedrail Corp., showed a new electric feed rail suitable for providing power to crane trolleys and to portable electric tools and other electric equipment. All electrical parts are completely inclosed and protected.

Fluid Handling

New developments among valves, pumps and pipes were well represented at the Show. Several valve manufacturers showed large steam valves of the bonnetless type which were, in the main, a wartime development. These were in general of two sorts, the Hobbs Pressure-Seal valve (shown by several manufacturers) and the Lunkenheimer Breech-Lock bonnet valve, a development of the Lunkenheimer Co., Cincinnati. Indicative of the weight savings possible with the Hobbs construction, the Crane Co., Chicago, showed two 8-in. valves, one of conventional and one of Pressure-Seal construction, mounted on scales. The weight of the conventional unit was 2,027 lb., and of the Pressure-Seal type, 899 lb.

Featured by the Armstrong Machine Works, Three Rivers, Mich. was a new refrigerant foul gas purger which removes air and non-condensible gases without loss of refrigerant. The refrigerant from the liquid receiver enters the purger through a pilot operated valve where the refrigerant gas condenses on a refrigerated coil, while air and gas collect in the upper part of the chamber. A float controlled valve allows the gas to escape from the top of the purger.

Among the new regulating valves shown by Leslie Co., Lyndhurst, N. J., was an improved balanced pressure controller, Model DF-1. This valve consists of a control pilot and diaphragm regulating valve. A line of microflow valves was exhibited by the Fisher Governor Co., Marshalltown, Iowa. They are designed to operate under pressures as high as 10,000 psi. and can control flows as low as 0.002 cu.ft. per second of air at a 300 lb. pressure drop. Also shown by Fisher was a new diaphragm motor for control valves. It is reverse acting, air opened, spring closed, and requires no stuffing box.

Two new safety valves shown by the Foster Engineering Co., Newark, N. J., are designed for steam pressures up to 3,000 lb. per sq.in. and temperatures up to 1,000 deg. F. Also shown by this company was a line of air-operated hydraulic pressure regulators for steam pressures up to 125 lb., as

Since the last Power Show, held in 1944, there have been a large number of improvements in mechanical equipment, particularly in the fields of industrial instruments, materials handling equipment and power transmission devices. Perhaps the innovations have not been as radical as in past years, but they are important nevertheless. The 1946 Show was especially well supplied with exhibits of these types. Unfortunately heavy equipment makers were not well represented.

well as for heating systems, stills, cookers, and low pressure water and oil service.

An addition to the line of Kaye & Macdonald, Inc., West Orange, N. J., is the type PR pressure regulating valve. It is pilot operated, with a variable V-port cage to produce modulated control. Larger maximum capacity at full opening permits a wide range of adjustments. Johnson Corp., Three Rivers, Mich., exhibited a single-seat, full-opening, direct-operated solenoid valve in sizes of ½ to 3 in. This new valve will operate under differential pressures as high as 150 lb. and will handle hot liquids or steam up to 365 deg. F.

A complete new line of valves in globe, gate and angle patterns for pressures to 2,500 lb., and sizes to 2 in., was exhibited by Manning, Maxwell & Moore, Watertown, Mass. These so-called Weldvalves feature the maximum amount of welding in the production of the valve with consequent saving in weight and better distribution of metal for increased strength.

McAlear Mfg. Co., Chicago, Ill., showed an improved Type H-1515 diaphragm motor valve which can be easily changed from normally open to normally closed positions by merely changing the position of the spring assembly. This valve is designed for use in pilot plants for handling relatively small flows. Henry Vogt Machine Co., Louisville, Ky., exhibited a new short bonnet gate valve in sizes ½ in. up to 6 in. for steam or oil service, as well as ¼ in. up to 2 in. gate valves with bolted bonnets and glands for steam plant service.

Among pumps was a newly developed "packaged" type boiler water conditioning unit for applying treating compounds in small plants, shown by Proportioneers, Inc., Providence, R. I. The unit includes a proportioning pump mounted on the same base with the motor, chemical tank and agitator. This company also showed a new duplex feeder consisting of a proportioning pump with twin reagent heads individually adjustable but driven by the same motor. Another pump manufacturer, Sier-Bath Gear & Pump Co., North Bergen, N. J., exhibited certain improvements in its screw pumps, as well as a new rotary pump known as the Gearex, employing continuous herringbone gears, for capacities up to 550 g.p.m. and pressure to 250 psi.

Among developments relating to piping was a flexible ball joint pipe connection for absorbing vibrations set up by pumps, shown by Barco Mfg. Co., Chicago. A new item in the booth of the Chicago Metal Hose Corp., Maywood, Ill., was the CMH compensator which compensates for offset motion in pipes caused by vibration. Also featured was a new moisture-proof conduit for electric wiring. A multitude of seamless welding fittings was on display in the booth of Ladish Drop Forge Co., Cudahy, Wis. These seamless fittings are a new line with the company, mostly available in nominal sizes from ½ in. to 30 in. Its newly developed flareless tube coupling, the Selulok, was exhibited by Parker Appliance Co., Cleveland, Ohio. A special ferrule slipped over the tube end digs into the tube as the coupling is tightened, making a joint which is said to hold against high pressure with all grades of commercial welded and seamless tubing.

Designed to smooth out the pulsations in gas flow is a new pulsation dampener shown by the Fluor Corp. Ltd., Los Angeles. Effective over the range from vacuum to 4,000 psi., this unit consists of two storage chambers, interconnected with piping. It is claimed to cause a pressure drop of only ½ percent of operating pressure and to remove in excess of 95 percent of the pulsation peaks.

The Drainmaster, a new hand tool for blowing out plugged pipelines with a shot of compressed air, was introduced at the show by Locke Regulator Co., Salem, Mass. The gadget consists essentially of a rubber snout to be inserted into the plugged drain pipe or other line, a small pressure chamber, and an air pump. Pressure is released suddenly into the pipe with a trigger. Another new item in the Locke exhibit was the No. 60 gas and air control valve; it requires only about two-thirds as much headroom as predecessors of the same capacity. Shown by the Watson-Stillman Co., Roselle, N. J., was a portable hydraulic pipe bender with separate dies for handling ⅜ in. to 3 in. diameter pipe. The bender is of the table type and consists of a hydraulic cylinder with built-in pumping unit. Also shown by this company was a solid block type pipe fitting of various special alloys, machined out of bar stock.

Heat and Power

It is somewhat surprising that more equipment for the production and transfer of heat and the generation of power was not evident at the Power Show. Capitalizing on the current interest in gas turbines, Allis-Chalmers Mfg. Co., Milwaukee, showed cut-away views of gas-turbine construction, demonstrated the effect of powdered coal ash on turbine blading and showed how gas turbines might be used for railway propulsion.

In the field of heat transfer equipment, Davis Engineering Corp., Elizabeth, N. J., showed an automatic variation of its Paracoil self-cleaning tubular heat exchanger, a device employing bayonet type tubes and longitudinally movable baffles to scrape the outside of the tubes. This exchanger can now be provided with motor driven mechanism, controlled by a cycle controller, for automatically scrapping the tubes at predetermined intervals. Another type of heat exchange equipment, exhibited by Niagara Blower Co., New York, is a bantam model of this company's Aero Pass condenser for small refrigeration systems. This evaporative type condenser operates under automatic control to provide condensing action for refrigeration systems of 2 to 7 tons rating.

Among the items exhibited by the Modine Mfg. Co., Racine, Wis., was the Power-Throw, a horizontal delivery

unit heater designed for special industrial applications. Also on exhibit were Modine type G oil coolers and heat exchangers for liquid-to-liquid cooling. Fred H. Schaub Engineering Co., Chicago, showed a new deaerator intended primarily for small and medium sized boiler plants. This equipment removes over 99 percent of the oxygen from boiler feed water by heating the water and then spraying it into a vessel where dissolved gases are released. An improvement in heating equipment shown by L. J. Wing Mfg. Co., New York, featured a steam-driven turbine for revolving the fan in an industrial type unit heater. The exhaust from the turbine is piped into the heater section.

A new "gravity-lock" construction for brick furnace wall depends on six basic firebrick shapes to tie the inner furnace lining to the standard brick section of the wall. This prevents the inner walls from failing due to breaking of the holding headers. This new construction was shown by the Waite Construction Co., Providence, R. I.

Instruments

New developments in instruments, mainly industrial, were well represented at the exposition. Allis-Chalmers Mfg. Co., Milwaukee, demonstrated a new method of telemetering, suitable for remote indication and control in a wide variety of applications. This device uses direct current of two-phase, sinusoidal character and consists of a rotary transmitter, either manually or automatically actuated, and any desired number of receivers up to the wattage output rating of the transmitter. As the transmitter is rotated, all receivers follow its rotation with an accuracy of plus or minus 1 deg.

A new oxygen recorder was shown by the Bailey Meter Co., Cleveland. Measured quantities of gas sample and a vaporized standardized liquid fuel are passed over a platinum filament. This mixture is burned and the heat liberated by combustion maintains the filament at a temperature proportional to the oxygen content of the sample. The filament forms one leg of a bridge circuit and any unbalance is magnified through an electronic amplifier. This company also showed for the first time an area type flowmeter in which the flow of liquid raises a V-port plunger which varies in height according to the volume of flow.

The Bristol Co., Waterbury, Conn., displayed the new Dynamaster resistance thermometer, a high-speed electronic instrument operating on the null balance principle. The only moving part is the balancing motor mechanism.

Two new instruments were featured in booth of Brown Instrument Co., Philadelphia. One of these was an on-off, snap-acting, vane-type electronic controller. When the pen deviates from the control index setting, the vane passes between a pair of oscillating coils to give a snap action type of control. Also shown was an adjustable ratio controller known as the Indexet. It has an adjustable zero shifting device which will shift the zero from −100 to 0 to +100 percent. A span shifting device has a range from zero to 200 percent. A new integrator shown by the Taylor Instrument Cos., Rochester, N. Y. is claimed to be more dependable and accurate than those previously used. This integrator uses a square root cam with a specially designed device for centering the position of the cam without appreciable loading, to prevent any drag on the pen mechanism. A pulsation dampener for use in pressure gage and flow meter lines was also shown by this company. It consists of a tubular case with a series of small compartments similar to the muffler of an automobile.

Shown by Builders-Providence, Inc., Providence, R. I., was a midget differential meter for flow or liquid level. Differential pressures up to 200 in. of water at pressures up to 500 psi. may be measured. Included in this exhibit was a new electrical receiver for mechanical flow meters. Cambridge Instrument Co., New York, featured a direct-reading, portable pH indicator which employs a glass electrode and an electronic measuring circuit. The a.c. unit is complete in itself. A gas analyzer which can measure five different gases instead of the previous maximum of four was also exhibited. Gases measured are CO_2, H_2, CO, O_2, and CH_4.

On display by the Foxboro Co., Foxboro, Mass. was a new electronic potentiometer. Continuous balancing is provided by a simple rotating variable air capacitor driven by a double-solenoid type drive which moves only when the instrument is rebalancing. Full scale pen travel in as little as one second on a standard 12-in. circular chart provides rapid recording.

Hays Corp., Michigan City, Ind., showed a new oxygen meter based on the magnetic property of oxygen. This device utilizes two thermal conductivity cells one of which is located between the poles of a permanent magnet, the other serving as a reference cell. Oxygen in the gas sample is magnetized, increasing the rate of circulation over the heated filament to produce a cooling effect which is proportional to the amount of oxygen in the sample.

Featured by Kieley & Mueller, Inc., North Bergen, N. J. was a diaphragm control valve using tubular steel yokes with a pressed steel boltless diaphragm case held together with a clamp rather than in a conventional style. Also shown by this company was a new bourdon tube pressure pilot valve for handling pressures from zero to 10,000 psi.

Leeds & Northrup Co., Philadelphia, featured its new Speedomax G electronic potentiometer which differs from the standard Speedomax in that it employs a converter and amplifier for operating the balancing motor, instead of Thyratron tubes. It has full scale pen movement in the time of 2.7 seconds and is available as a multiple point recorder or indicator.

Penn Industrial Instrument Co., Philadelphia exhibited a recorder which contains a full pad of 100 circular

charts. The pad of charts is installed and correctly positioned so that each day, a chart may be readily removed to leave a fresh chart in place. Here too was shown the Hays-Penn mechanical flow meter in which the conventional stuffing box is replaced by a magnetic coupling.

A number of new developments were shown by Photoswitch, Inc., and its associated company, Combustion Control Corp., Cambridge, Mass. One was a new electronic timer for interval timing, time delay, repeat cycling and programming. Also exhibited was a new electronic combustion control designed to monitor either the main flame, the pilot flame, or both, and also to protect against low water.

Republic Flow Meters Co., Chicago, displayed an improved transmitter for differential pressure, in measuring density, flow and liquid level. Also shown was a pneumatic differential pressure receiver which activates a moving armature within a divided coil in a bridge circuit to supply current to a watt-hour meter for integration.

Schutte & Koerting Co., Philadelphia, exhibited an electric recording rotameter which combines this company's rotameter with the Foxboro Dynalog electronic recorder. Uehling Instrument Co., Paterson, N. J., showed its Tank-O-Meter with a high-low alarm, equipped with a high pressure (250-300 lb. per sq. in.) bubbling bottle which eliminates the need for pressure reducing valves.

Materials Handling

Attention in the exhibit of the Automic Transportation Co., Chicago, was directed to the first showing of the Transtacker, an electric-driven, high-lift hand truck with a 6 ft. lift and 4,000 lb. capacity. A new conveyor belt was shown by the Baldwin Belting, Inc., New York. This heat resistant belt is of four-ply duck with three plies of asbestos. The Hustler, a portable power booster for gravity conveyor lines, made its Power Show debut in the booth of E. W. Buschman Co., Cincinnati. Powered by a ½-hp. motor, its driven belt has a load capacity of 500 lb. and either or both ends can be set at any height up to 7 ft. above the floor. Another Buschman innovation was an overhead trolley conveyor, in which the trolleys are hauled along by a cable rather than the customary chain.

The new Palletier, an electric fork truck, was shown by the Crescent Truck Co., Lebanon, Pa. The Palletier's hoist will tilt forward and backward and can lift 4,000 lb. through a height of 108 in. Ironbound Box & Lumber Co., Hillside, N. J., introduced a new line of standard materials-handling accessories, including dollies and pushtrucks in various sizes, a barrel skid, and a prybar.

Quite a number of materials handling items were introduced at the Show by Island Equipment Corp., New York. One was a light-duty, portable gravity roller conveyor made of aluminum. Another was a "reversible" roller gravity conveyor; that is, it can be used either side up. In addition there were a straight-line bottle unscrambler and a rotary unscrambler. Lewis-Shepard Products, Inc., Watertown, Mass., showed new electric powered, hand-guided trucks of both the platform and pallet types, designed to permit all operations with the handle in any position, including vertical. A light-weight (210-lb.) hydraulic hand lift truck for 2,000-lb. loads on two-faced pallets was the outstanding new item in the exhibit of Lyon-Raymond Corp., Greene, N. Y. To facilitate movement of loads up to 6,000 lb. between levels in the plant of not more than 5 ft. in difference, Service Caster & Truck Division, Chicago, Ill., displayed a new electric leveler consisting of a cable-hoisted platform supported on four vertical columns and lifted by an electric hoist provided with automatic high and low level stops.

Speedways, Inc., Buffalo, N. Y., unveiled its new De Luxe conveyor for sanitary applications. It is a "skate-wheel" type with aluminum wheels and cadmium-plated steel frame. The same company also showed a 45-deg. skate-wheel flip switch, which differs from earlier gravity conveyor line switches in that it does not split the line as a Y, but rather permits a spur to branch from a straight line at an angle of 45 deg. A third new item in this exhibit was Speedlift, Jr., a portable, light-weight booster table for gravity conveyor lines.

An all-steel belt conveyor was on exhibit at the booth of the Steel-Parts Mfg. Co., Chicago. The belt consists of sheet steel belt plates linked together. By taking out or putting in new links the belt may readily be lengthened or shortened. Shown for the first time by Stephens-Adamson Mfg. Co., Aurora, Ill., was a new Swiveloader for loading box cars and for throwing bulk material into storage. It operates on a centrifugal belt principle, discharging solids by centrifugal force.

Two new gas-powered fork lift trucks were unveiled by Towmotor Corp. of Cleveland. The first, for outdoor work, is equipped with pneumatic tires, in capacities of 4,000, 5,000 and 6,000 lb. The other is designed for indoor work for capacities of 1,500 and 2,000 lb. An improved fork truck shown by Wright Hibbard Industrial Electric Truck Co., Phelps, N. Y., featured electric operation, front wheel drive, rear wheel steer, hydraulic lift and tilt and battery power for the handling of loads up to 2,000 lb. It was said to be exceptionally light in weight for its capacity. Yale & Towne Manufacturing Co., Philadelphia, showed its newly acquired Kron line of crane and platform scales, as well as two new additions to its line of Worksaver electric trucks.

Power Transmission

As might be expected, the Power Show brought out many improvements in power transmission equipment. For example, American Blower Co., Detroit, showed a new design of fluid drive for high power delivery at high

speeds. The hydraulic transmission unit is mounted in the upper part of the oil reservoir tank which also contains the oil coolers and the oil circulating pump. Congress Die Casting Div., Detroit, had on display a number of its new zinc die-cast pulleys.

Shown by the B. F. Goodrich Co., Akron, was a variable speed selector in which two V-belts and four variable pitch pulleys provide any speed from full forward down through zero and into full reverse. The drive adds a novel planetary motion to permit reversing. It is available in ¼, 1, and 2 hp. units (output rating). Also shown by Goodrich was a new line of flexible couplings in which rubber disks or load inserts are used between the metal couplings.

In recent years there has been considerable trend toward the use of various kind of accelerating clutches for the transmission of power from a motor to its load. One such device was shown by the Hardinge Co., York, Pa., the BLM clutch. This unit is of the type in which the driving element consists of a number of weighted shoes carrying friction material and driven by a spider. Under acceleration the shoes bear against the inner periphery of the driven drum, to accelerate the driven load slowly without overload on the motor. A similar result was accomplished differently in the Mercury clutch, shown by the Mercury Clutch Corp., Canton, Ohio. Here the driving element is forced against the driven element by the pressure developed by the centrifugal force of a small amount of mercury. Still a different method was that exhibited by the Link-Belt Co., Chicago, in the new Electrofluid drive, which is a combination of motor and hydraulic transmission built as a single unit.

Something novel in worm-and-gear speed reducers was shown by Michigan Tool Co., Detroit. By making the worm face concave, hourglass fashion, more teeth come into play, thus increasing power transmission capacity with no increase in size. Several developments in variable speed transmissions were shown by the Reeves Pulley Co., Connersville, Ind. Among these was a new preset speed controller. Once set for a given output speed, the device automatically maintains that speed through the action of a generator on the output shaft connected into a bridge circuit which contains the speed regulating motor. Another improved variable speed device was a hydraulic control for varying the output speed of the Motodrive type of speed-reducing variable speed changer.

The featured item in the exhibit of the Thomas Flexible Coupling Co., Warren, Pa., was a single-type coupling which can support weight as well as transmit torque, thus eliminating one bearing of one of the connected machines. Vickers, Inc., Detroit, had on display various new vane-type pumps, pressure control valves, and volume control valves—all for use with oil hydraulic power systems.

A number of new electronic remote control devices were shown by Yardney Laboratories, Inc., New York. The Synchro Link will simultaneously position any number of driven members, motor-driven valves for example, from a central point. The Flectrol is a device for remotely positioning any variable speed transmission.

Separation

Small diameter cyclones, built smaller in diameter than those formerly used for dust collection, were exhibited by Aerotec Co., White Plains, N. Y. They are being used experimentally in removing fly ash from the gas stream going to coal-fired gas turbines. This exhibitor also showed a combination fly ash precipitator using Aerotec tubes in the first stage, and an electrical precipitator in the second stage.

Designed to purify lubricating oil for diesel engines, the new Puri-filter Model 45 was exhibited by the De Laval Separator Co., New York. This device is a combination of this company's Uni-Matic Oil Purifier with a Fram Filcron filter, said to insure removal of water and solids.

Several new devices for removing tramp iron from a moving stream of process solids were demonstrated by the Eriez Manufacturing Co., Erie, Pa. One is a permanent-magnet, belt-and-pulley type, another a new permanent-magnet, self-cleaning, drum-type separator. J. A. Zurn Mfg. Co., Erie, Pa., exhibited improved pipeline strainers including a duplex type having its two integral valves operating simultaneously by a single hand wheel when either strainer is to be cut out of service, another featuring a transparent plastic casing.

Various Innovations

Belco Industrial Equipment Division, Inc., Paterson, N. J., exhibited a semi-automatic ion-exchange and silica removing process for water treating. A novel device for fine grinding—a steam-jet coal pulverizer—was shown by Blaw-Knox Division of Blaw-Knox Co., Pittsburgh. Essentially it consists of a pipe loop in one leg of which is a centrifugal classifier. At the bottom of the loop several jets of high velocity superheated steam are introduced roughly tangential to the inner radius of the loop. Raw fuel, fed by a screw through a venturi steam nozzle, is jetted up the uptake leg of the loop and around the upper bend, whence the particles pass down through the classifier, oversize recirculating. The output is conveyed directly to the furnace burner by means of the flow of steam leaving the unit.

The Metalock Casting Repair Service, Long Island City, N. Y., showed what can be done with its novel process for repairing cracked or broken castings. The process has been used in the power and marine fields for the repair of broken machine parts, but so far has not been extensively employed in the chemical industry. Its chief advantage over welding is the fact that no heat is involved, so that corrosion resistance of alloys may not be impaired. Repair is accomplished by cutting several short slots of novel shape across the crack and driving into them metal locks shaped like the slot.

EDITORIAL VIEWPOINTS

NO TIME FOR TARIFF TINKERING

WHAT have been officially hailed as the "largest trade agreement negotiations" in the history of the United States are now getting under way in Washington. Reciprocal pacts with 18 key nations were under consideration in the hearings that started January 18. If and when these multilateral trade agreements are consummated they will have resulted in a broader tariff revision than has ever been accomplished on a piecemeal basis. Perhaps this is in keeping with the enlightened and non-partisan foreign policies that seek to increase production and distribution of goods throughout the world to the end that all peoples may have higher living standards. Yet one cannot help but wonder if this is an appropriate time to undertake such a tariff revision.

Half the world is prostrate—with millions of people looking to this country for help in reestablishing their industrial economies. Meanwhile, we have been engaged in pushing our wages and prices high above prevailing world levels, as if to invite competition in our own markets from foreign manufactures produced in countries with much lower costs. Today there may be only a trickle of goods coming from such countries but given the opportunity to enter our markets under reduced tariffs, we are certain to feel that competition. Certain chemical industries would be particularly vulnerable to attacks by exports from low-cost countries seeking to recapture the markets once dominated by Germany and Japan. In this period of transition from war to peace, when facts are lacking on present as well as prospective developments abroad, it seems an inappropriate time to do more than make a preliminary survey of the problems ahead for a World Trade Charter and International Trade Organization.

RESOURCEFUL RESEARCH

ACCORDING to some estimates the group of petroleum companies that are served by the Standard Oil Development Co. annually spends more than twelve million dollars for research and development. Since this large sum must come from thousands of investors, they are quite naturally interested in learning what sort of a return they are getting for their money. Part of the answer was given by SODC president, Robert Price Russell, late in November when he addressed the annual meeting of the Advisory Council of the Southern Research Institute in Birmingham.

Confining his study to research carried out during the past ten years on manufacturing and processing of petroleum products, Mr. Russell compared his company's research costs with, first, the savings in royalty payments that would otherwise have gone to outside research and development groups, second, with savings in manufacturing costs through improvement of existing processes and products and, third, as added profits realized from new products developed. The savings in royalties which otherwise would have been paid to outside groups amounted to $3,700 for each thousand dollars spent by SODC on research and development; profits realized through process and product improvement were $9,600 and profits from new products were $2,100. Thus a total of $15,400 of added profits accrued to the stockholders for each thousand spent by the research and development groups. And this handsome return brought with it additional benefits in the form of insurance against future contingencies.

Special significance attaches, therefore, to Russell's further statement that nearly a third of SODC's present program is directed toward the conversion of natural gas and coal into liquid fuels. This is not so much a hedge against any future shortage as it is a practical means for offsetting the continuing increase in the costs of finding and producing oil. Pilot plants have demonstrated that our large existing reserves of natural gas can already be converted into gasoline at costs that appear to be competitive with crude oil. Synthetic gasoline from coal requires additional plant facilities and is therefore more expensive to produce. "But even with a fair return on the greater investment," it is Mr. Russell's opinion that "American motorists could operate their cars on synthetic gasoline from coal at an average additional cost of not more than 10 cents per day."

CHEMICAL CAPONIZERS

INDIRECTLY we have learned with interest and some apprehension of the recent success of the Larrowe division of General Mills in turning roosters into capons without the aid of surgery. They mix in the feed given to roosters they want to caponize, doses of either one of two synthetic female sex hormones—dimethyl ether of diethyl stilbestrol or dianisyl hexane. A few doses and the rooster's shrill crow turns into a weak falsetto, he loses his comb and his strut—in fact he loses all his masculine traits and becomes, in fact, a capon since the female hormones overcome his natural male inclinations. Just about a week is needed of this special diet and the rooster's crow is stilled. The bird grows to 6 to 10 lb. with fat distribution and breast development of an adult hen while the meat takes on the tenderness and succulence of the true capon—at least so we have been told.

Only catch so far, according to Maxwell L. Cooley, chief chemist at the Rossford, Ohio, plant, is that the Federal Food and Drug Administration refuses to allow roosters caponized by the feed method to be shipped in interstate commerce as food. The Washington guardians of our health and happiness are afraid that the human male eater may assimilate enough of the synthetic female hormones from the meat to affect his own virility. Cooley says such is not the case since there have been plenty of

these treated roosters on the General Mills farm and the men there still seem plenty virile. However, they don't eat the capon's liver, gizzard or heart where these caponizers are most likely to concentrate. Whether or not a new branch of chemical industry is in the making remains to be seen. Our guess is not—at least as long as the Federal Food and Drug Administration persists in its present stand.

FROM ACETONE TO XYLOL

War Assets Administration announces that it would like to sell surplus industrial chemicals ranging from acetone to xylol which cost the government at least $35 million when bought for war purposes. Back 12 to 15 months there were many chemical companies that thought the offering of such surplus might cause a serious setback in the opportunity to sell newly made products. That has proved an unfounded fear.

Most purchasers today can get much less than they want of many of their chemical raw materials. Everything from crude heavy chemicals to the rare research compounds seems to be scarce. It will be a good thing for everyone, including the federal taxpayers, if purchasing agents will see if they can satisfy some of their urgent needs from Uncle Sam's surplus store. A bit of letter writing to each of the regional offices of WAA may help a lot.

CAN EMPLOYERS BE ACCREDITED?

Our contemporary, *Civil Engineering*, presents in its January issue the thought-provoking proposal that employers of engineers should be accredited for their employment policies on much the same basis that educational institutions are now accredited for their scholastic standards. Frederick H. McDonald, a past director of ASCE, cites the serious faults of labor unions in their unwillingness to agree upon standards of performance for employers and employees. He feels that engineers have it within their power and ability to set up "standards which if met by an employer will hold him secure as long as he maintains them—and standards which must be met by employees to hold their rights secure."

We are frankly skeptical of the desirability as well as the practicability of such a grandiose scheme. It smacks too much of an arbitrary "blacklist"—a surrender to the leveling tactics of the labor unions in subordinating individual opportunity and enterprise in favor of pressure groups. But there is a germ of thought in the idea that recognition is long overdue those employers of technical men whose long-established personnel policies and performance offer proper incentives for professional advancement.

DON'T IGNORE THE SOVIET

Research men and process executives are becoming disturbed because the U. S. Patent Office pays so little attention to Soviet technology. One cannot even find in our Patent Office library, the official bulletin issued by the Soviet Government to abstract the patents it has granted. And nothing has been done to secure exchange of patents between our Patent Office and the Soviet Bureau of Inventions.

We believe that this is wrong. One cannot expect full cooperation from Moscow. However, that does not excuse the present apparent lack of effort to get what we can have from that source. We think that American research men and industrial executives should make their sentiments on the subject known to Commissioner of Patents, Casper W. Ooms.

HONORS LONG OVERDUE

In 1888, while still a student in his teens at M.I.T., Ernest A. LeSueur, developed an electrolytic cell for the manufacture of caustic soda and chlorine from salt solution. No less authority than Dr. Colin G. Fink has written (See *Trans. Electrochem. Soc.* Vol. 63, 1933, p. 87) that LeSueur's "classical experiments served as the foundation of the world's electrolytic alkali-chlorine industry." Significantly, his achievement was not limited to the mere design of an electrolytic cell—even though it was so efficient that it continued in operation for more than forty years. Again quoting Dr. Fink: "It was LeSueur who conceived the idea of maintaining a pressure on the anolyte, using at first a mechanically non-pervious diagram and, later, a mechanically porous one with accompanying bodily transfusion of anolyte."

Elsewhere in this issue we are privileged to publish an abstract of the paper presented by Mr. LeSueur in Toronto on November 28 when he received the SCI Canada medal. This long delayed honoring of a pioneer in Canadian science and technology brings a great deal of satisfaction to us, for it was first in this magazine in May, 1910, that Mr. LeSueur was recognized editorially as the very young father of the electrolytic alkali industry. Today at almost 80 he still retains much of the energy, vision and enthusiasm that have characterized his long fruitful career in the service of the Canadian chemical industry. It is a pleasure to congratulate such an old and deserving friend.

Volume 54—Chemical Engineering—Number 1

Chemical Engineering, with which is incorporated *Chemical & Metallurgical Engineering*, is the successor to *Metallurgical & Chemical Engineering*, which in turn was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*, effected in July 1906.

The magazine was originally founded as *Electrochemical Industry*, in September 1902, and was published monthly under the editorial direction of Dr. E. F. Roeber. It continued under that title until January 1905 when it was changed to *Electrochemical & Metallurgical Industry*. In July 1906 the consolidation was made with *Iron & Steel Magazine* which had been founded eight years previously by Dr. Albert Sauveur. In January 1910 the title was changed to *Metallurgical & Chemical Engineering*, and semi-monthly publication was begun Sept. 1, 1915. On July 1, 1918, the title was changed to *Chemical & Metallurgical Engineering* and weekly publication was begun Oct. 1, 1919. Monthly publication was resumed in March 1925.

In August 1946 the words *"& Metallurgical"* were dropped from the main title to bring its name more in keeping with the editorial content.

Dr. E. F. Roeber was editor of the paper from the time it was founded until his death Oct. 17, 1917. After a brief interim he was succeeded by H. C. Parmelee. Ten years later, Nov. 1, 1928, Mr. Parmelee assumed other responsibilities in the McGraw-Hill Publishing Company and Sidney D. Kirkpatrick was appointed editor.

The present editorial staff of the magazine comprises, in addition to Mr. Kirkpatrick: James A. Lee, managing editor; H. M. Batters, market editor; T. R. Olive, associate editor; L. B. Pope, R. W. Porter, E. C. Fetter and R. F. Warren, assistant editors. Editorial representatives are: J. R. Callaham and J. F. Cosgrave, San Francisco; R. S. McBride and J. V. Hightower, Washington; E. S. Stateler, Chicago; and Earle Mauldin, Atlanta.

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ENGINEERING RESEARCH

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AN ANALYSIS OF SOME PROBLEMS INVOLVED IN ORGANIZATION OF THE ENGINEERING RESEARCH FUNCTION IN INDUSTRIAL ENTERPRISES

ENGINEERING research should be distinguished from pure scientific research on the one hand, and from so-called industrial research, on the other. It is generally acknowledged that the aim of industrial research is the application to industry of the principles being constantly evolved in scientific laboratories. In the pursuit of this objective, industrial research does not necessarily differ from pure research in methods or practices.

For this reason the bulk of the work done in industrial research is not undertaken in specific industrial enterprises, but is done in cooperative research institutes, universities and other educational institutions under the industrial fellowship system, and in government sponsored laboratories. This is largely due to the high cost involved and the similarity of the work to pure research being undertaken at the same institutions. Only the largest of our commercial enterprises can afford the laboratories and staffs required in modern industrial research.

Concerning the distinction between industrial and engineering research, the eminent English engineer, Harry R. Ricardo, said in a presidential address to the Institute of Mechanical Engineers, "The two are distinct, not only in their objective, but also in their method of approach and call for a different temperament and mentality and for a different technique." Concerning these differences in the personalities involved (which, after all, are of prime importance to the organizer and administrator) he continued, "The fundamental research worker is usually a pure scientist and one who approaches his problem in a strictly logical manner; to be successful he must not only have a thorough knowledge of his subject, but he must be endowed both with imagination and unlimited patience. He is usually neither pressed for time nor limited by expediency, whereas the applied research worker very often finds himself racing against time and forced to compromise. To be successful, the applied research worker must have a vivid imagination, but experience, sound judgment and common sense are more important to him than scientific eminence."

Far from requiring expensive laboratories and staffs, the engineering research function is carried on, to a greater or lesser degree, in all manufacturing enterprises. It may consist of one man whose only staff is his slide rule and engineering handbooks and whose laboratory is the manufacturing plant itself, or it may consist of many engineers more or less elaborately organized and equipped. It is often called the "Development Department" or "Engineering Development" or it may merely be a part of the General Engineering Department and have no title at all (it is seldom called "engineering research").

Functions of Engineering Research Department

The existence of such a department may often be denied in industrial organizations, but upon careful analysis it is likely that some person or group of persons will be found who are performing the functions which may properly be ascribed to it. This analysis of function is, of course, basic to sound organizing and constitutes an

As the author spendidly reasons, engineering research is distinctly different from industrial research and pure research, and requires men of a different temperament and mentality. The three should never be grouped in a single general engineering department. He analyzes some of the problems involved in organization of the engineering research function in industrial enterprises, and approaches the problems from the standpoint of the basic principles of sound management. His discussion of the functions, scope, operation and place of engineering research within the organization should appeal to chemical industry management. It should assist him with his plans.

excellent point of departure in setting up such a department where none exists in name, or in reorganizing existing facilities. These functions, which will be considered in turn, are: (1) service to other departments; (2) development, primarily of new methods, materials or processes; and (3) research connected with or leading to development. The organizational set-up should be sufficiently flexible so that as changing conditions impress varying emphasis on one or the other of these functions, the department will be able to shift its work to meet the new demands without undue strain.

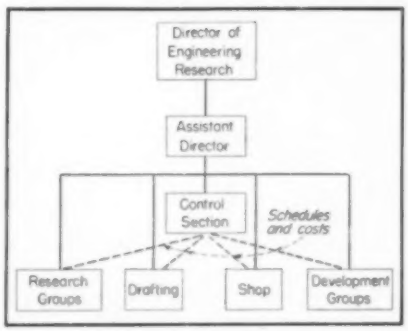
Service

Service to other departments of the business, while by no means the most important function, is the one activity which must be carried out in any type of an organization, however rudimentary. This function entails the handling of special (not repeated or routine) requests to the engineering department. These special requests usually are requests for consulting service of a technical character. A few examples should suffice to illustrate their nature and should show that they exist in all manufacturing enterprises, whether recognized or not (and whether a formal engineering research section exists or not). Thus, in one typical case, the sales department might be requested by a customer to advise as to a possible method for accomplishing a particular operation on the seller's product. If this happens to be something new, the sales department will not ordinarily be in a position to give an answer.

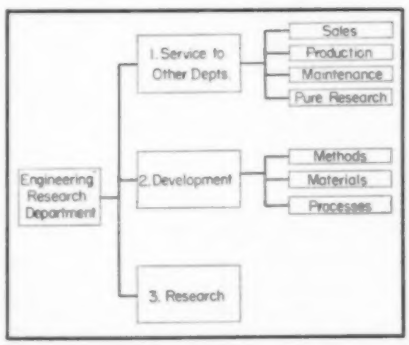
If there is no Engineering Research Department, the question will be turned over to General Engineering, where someone who is recognized for his ingenuity will sketch up one or more possible means of accomplishing the desired objective. The sketches will then be turned over to Sales for delivery to the customer. In the larger organizations, and particularly if there is an Engineering Research Department or its equivalent, the sketches may take the form of a complete design of either process or machine.

Another example of this service function is illustrative of internal consulting. Thus, the Manufacturing Department might request a recommendation as to the best material to use in certain process equipment subject to some new corrosive condition. A second example of this, and one which may serve also to illustrate once more the difference between pure research and engineering research, might be in the form of a request from the Pure Research Department for the fabrication of equipment, the functions of which will have been fixed by the nature of the research work, but the form of which it would properly be Engineering Research's job to determine. In connection with this, it might be necessary to find an outside manufacturer who could make the equipment to meet the specifications.

Such requests as the above are commonly handled by General Engineering, but an analysis of the content of these questions will generally show that what is desired is consultive service. For this reason it is not unusual to find that enterprises without a specific engineering research function will have only makeshift arrangements which for some cases and for a while will suffice, but will hardly render best service in the long run.



Organization of an engineering research department



Functions of the engineering research department

Summing up this function, we find that service is needed and is being rendered to a greater or lesser extent in every manufacturing enterprise. We have shown that it is a consulting service for all departments, and as such it represents and well deserves to be considered as one of the three staff functions to be performed by the Engineering Research Department. Having laid out this function as the one which cannot be eliminated, it follows that any organizational set-up or procedure should be designed to handle consulting service efficiently and effectively.

Development

The main function to be considered is that of actual development of new methods, materials or processes. In contrast to the previous function, we will find that this is not considered an inherent part of every business enterprise; on the contrary, the majority of companies do little or no specialized development work along these lines and that they depend on what has already been done to carry the company into the future. In particular, it has been found that it is the tendency of these companies who allow the General Engineering Department to carry out all of their research functions to be hesitant concerning the development of new ideas. In most cases the General Engineering Department will be content merely to make minor improvements in methods and machines in use.

This is particularly true in enterprises in which the product must be constantly restyled or revised, which redesigning is ordinarily the function of General Engineering while the changes in methods are ordinarily left to Production (where as a rule, what was good for the past is good for the future, and where ordinarily the technical requisites for best development do not exist).

It has been found further that in the case of some large companies, the development function has been left to the Pure Research Department, but here again (as noted before) the environment for best development does not ordinarily exist and the results are not too successful.

In other cases, another factor militates against the establishment of a special Engineering-Research Department: the existence of many outside consulting firms who are in a position to handle this type of work. Here the disadvantage lies in the fact that the developments will be costly, spasmodic and not continuing.

We see, therefore, that while for various reasons a department to handle this function may not necessarily be common in industry, it should be noted that an Engineering Research Department properly organized to continuously develop new methods, materials and processes will pay handsome dividends.

Development Research

The third function of a well-organized Engineering Research Department

is r·search leading to or connected with development. This function admits of less precise definition and example than the others, since it might appear to overlap pure research work or the development work described previously. It may best be considered by example.

Let us assume that a major product of a certain company is manufactured in a particular process by several machines operating in series. It is the function of the Pure Research Department to determine the best pressures, temperatures, feeds, etc., to produce the desired end result for sale from the equipment in use. They will also determine the best combination of raw materials, and may change these to give a new or better product. It is the function of General Engineering to install and maintain the machinery in its best operating condition, and to furnish to the machinery the proper amounts of power, heat or process fluids.

Where then, does Engineering Research fit into this picture? Suppose the process to be a batch operation, and further suppose that the Pure Research Department has come to the conclusion that if one machine could be made to perform its functions in a slightly different manner, the process could be changed to continuous. Pure Research is not in a position to design such a machine and General Engineering determines that there is nothing on the market which will meet the requirements. They also are not in a position to design such a machine, since the data on which a design might be based are not available to them.

Research Function

In order to design such a machine it is determined that it is necessary to design, build and operate several small models in order to obtain the physical constants and data which will be required. This then, is the research function of the Engineering Research Department: to design and build such experimental machinery and to perform experiments, collect data, and correlate same so as to provide adequate information leading to the development of a production device which will perform the desired operation. The research function should also include the maintenance of records of past experimental work and a file of new developments throughout industry so that the flood of new materials and ideas which are constantly being evolved may be promptly and efficiently applied to the manufacturing problems of the enterprise.

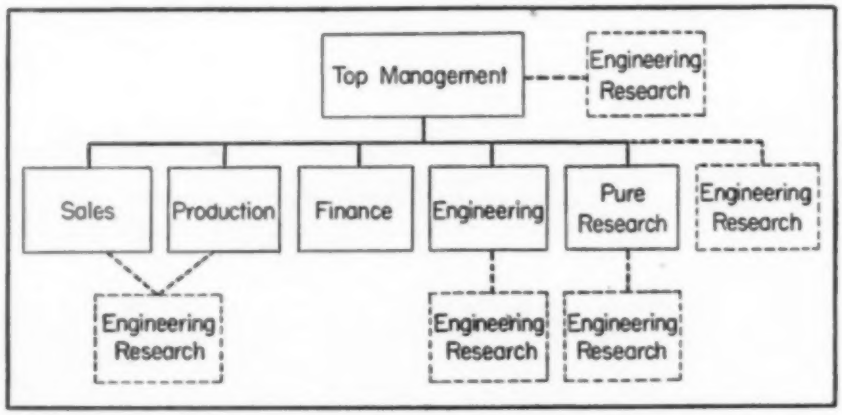
Having outlined the functions of a well-organized Engineering Research Department, it is now necessary to delineate the scope of such a department. The size and range of such a department will, of course, depend to a large extent on the nature of the industry involved. There will be a marked difference in the organization of such a department in heavy industry and in consumer's industry. In heavy industry, the department will probably be given wide scope in development work (service to other departments may become less important) or depending on the nature of the industry, the research function may be heavily stressed. If the equipment involved is high cost machinery, this last is likely to be true. On the other hand, in consumer's industry, the service function (particularly to the Sales Department) is likely to be most important, and if the general type of machinery used is low cost equipment, the development may consist largely of the design of speed-up devices and methods to use with this machinery.

As far as the over-all scope of the Engineering Research Department is concerned, the best policy appears to be, in most cases, to keep it as broad as possible. Recognizing the Department as a staff function, acting in an advisory capacity to management at the top and as consultants to all the various operating and staff departments, it should be clear that any attempt to specialize such a department in one field of engineering or along particular process or product lines would limit its possibilities.

No matter what the size of the company, it should be possible to maintain such a department so as to cover the broadest possible field of engineering. Obviously, the more types of engineering problems such a department is equipped to analyze, the more useful it will be both to top management, and to all the other departments of the enterprise. In a large company, with several operating departments and one or more plants, it should be possible to locate the Engineering Research Department in the central office so that experienced men in the various engineering fields will be available as consultants in a group for any problem which may arise at any of the company's plants.

Operation of an Engineering Research Department

Having arrived at the conclusion that the broader the scope of such a department, the greater its value to the company, it is necessary to discuss the proper system of operation consistent with sound organization. In principle, the system of operation should correspond to the objectives of the Engineering Research Department defined under its functions, and since we have outlined the basic principles under which it should attempt to attain these objectives above or under its scope, we now can consider the basic policies which should govern the operation of the Engineering Research Department.



Possible organizational relationships of engineering research department

The system should be such that when a problem arises or exists, it will be promptly brought to the attention of Engineering Research where it will be distributed to those persons most qualified to handle it, given the proper weight or priority rating (thus, a customer's request would probably take precedence over a long-range development program), recorded, estimated, solved and reported on, all following a definite pattern of work order.

Service

It may well be that each of the three basic functions of the Department will

have to be initiated in a slightly different manner. Thus, requests for service from other departments will probably best be given to the Engineering Research Department on a form which will allow an estimated cost of handling the problem to be reported directly thereon and returned to the originator for approval before the work is actually started. In order to make these estimates possible, and despite the fact that the entire department may best be handled from an accounting viewpoint as general expense—the Accounting Department should furnish to Engineering Research up-to-date standard costs for engineers, draftsmen, shop, etc. This may seem inconsistent in that there would offhand seem to be no necessity for estimating each job if the entire department is carried as general expense. No inconsistency is involved since in a properly organized enterprise a standard means will be provided for presenting the facts to those who are required to make a decision. These estimates of cost provide a tool (whether used as a direct charge against the operating department involved or merely carried over to general overhead) whereby management can weigh the advantages involved in having Engineering Research perform certain services against the cost of such service.

Development

Development work may initiate as a request from another department. Generally, the need for development work arises as a result of top management planning or grows out of a continuing research program policy. In a department especially set up to do engineering research, the probabilities are greater than they would be in the General Engineering Department that new ideas generated either internally or externally will be seized upon and carried through to a logical and profitable conclusion. It is in this process that a great number of ideas for development work arise in the form of suggestions and ideas which are not necessarily correlated with any particular problems being considered by top management or by the supervisors of the particular department concerned. If the personnel of the Engineering Research Department is carefully chosen for "inventiveness" or "imagination," this particular source is apt to be the most prolific of all.

What then, should be the general procedure or policy in handling this type of work? Costs of development are apt to be much more difficult to estimate and to be much higher than service work for other departments. This presents management with a quasi-paradox, since the greater expense involved, the higher the level on which must be made the decision to undertake the project and by the same token, the more precise is the estimate desired. Since development work usually involves some preliminary experimentation or trials, it seems wise to leave the authority to undertake these preliminary investigations in the hands of the head of the Engineering Research Department, limiting him only to a predetermined and set expense. If the idea or project looks promising, he should then have a report written stating the advantages, disadvantages, and an account of the work already done with an estimate (as close as may be possible under the circumstances) of the cost of the projected work. He may then forward this to the executive committee or other organ of top management authorized to approve such an appropriation. If the work done shows the development to lack promise, the same report should be written, with negative recommendations, for the record.

Engineering Research

The third type of work which must be handled as a matter of routine is engineering research. Neither of the two procedures described covers this need. Research should not be haphazard; nor can the results be evaluated in specific terms as is the case of development. Sound policy should permit that such work be done under a definite and continuing program of research, carefully set up and budgeted. The exact projects which may have to be covered will vary depending on the industry, but the basic objective should be common to all: a continuous source of data and information which can be translated into specific developments.

From a research standpoint, the Engineering Research Department should undertake a constant study of all of the basic processes involved in the manufacture of the company's products (and in consumer's industries, the study of the uses and fabrication of those products). Top management, in conjunction with the head of the Engineering Research Department and the heads of the various operating divisions, should decide yearly the content of this program and the budgetary allotments for the various phases involved. The head of engineering research should then translate this general program into specific assignments and projects in accordance with the internal structure of his department.

In such a system as outlined above, there should also be a definite and specific procedure for the handling of work of extreme urgency (whether it be service, research or development does not matter). This policy should be such that when permission is granted from the proper top management authority to do so, the usual procedures of intermediate approval, purchasing and the other standard routines may be by-passed in a pre-determined manner. If this is not done, and each case of urgency be considered individually, it will be found that as much, if not more time, will be consumed as in ordinary routine work.

Place of Engineering Research Within Organization

Using the policies outlined, it is necessary to consider the place of the Engineering Research Department in the organization structure as a whole, and then to consider the type of structure best suited to the department itself. It is obvious that this is a staff group and should have no line authority outside of the department itself. In a great many instances it will be found operating under the head of the General Engineering Department of the company. This is considered neither wise nor satisfactory from an organizational standpoint. The chief engineer of any large industrial enterprise deals mainly with problems of operation and maintenance, neither of which is the important factor to be considered in problems of service, development or research. Although fully aware of the objectives of engineering research, the chief engineer, beset with these major problems of his own, will find it extremely difficult, if not impossible, to refrain from using the technical abilities and physical facilities assigned to engineering research to aid in handling this type of work. It is, therefore, much better practice to have engineering research independent of general engineering.

Large and Small Companies

In the case of the small enterprise, where one man might be assigned to engineering research, he might be made staff assistant to the president or executive vice-president. Large companies, on the other hand, whose top management may include a vice-president in charge of research or his equivalent, would do well to consider setting up the head of the engineering research group on an equal level, or if this is not considered expedient, have him report directly to the top research executive.

Organization

The internal organization of the engineering research group should be kept as simple as possible. The head of the department should have one or two assistants reporting directly to him in a central office, where most of the work should be performed. If the company has several plants, he should have a local representative at each reporting to him. Under the assistants, should be a group of senior or project engineers (the number, of course, depending on the size of the overall organization) who in turn should have assistant engineers and junior engineers reporting to them. One of the engineers should be assigned in charge of a control section which will handle scheduling, records and costs, as will be discussed below under "controls." In a group of any size, a drafting department should be included under a chief draftsman (again, distinctly separated from the drafting section of general engineering, for the same reasons as outlined previously) who should report to the head of the Control Section. An experimental or model shop is a distinct advantage, and if possible, should be included in the organization, with the shop foreman reporting also to the head of the Control Section. The Control Section engineer should report to the assistant who distributes and directs the projects.

If the group is large enough to warrant, there are advantages in forming distinct research and development groups within the Engineering Research Department. This allows a more flexible and more controllable structure. Each of these groups would be headed by an engineer, who would then report directly to the assistant to the head of the department. The internal structure, although directed on a line basis, should be co-ordinated from a staff standpoint. In the case of small groups, the best policy would be to keep the individual members as technically broad as possible. On the other hand, an advantage of the large Engineering Research Department is its ability to profitably utilize specialists in the various engineering fields by making them available as consultants to the entire group.

Coordination and Control

Once the structure of the department has been crystalized and its relationship to the remainder of the organization determined, the problem of properly controlling its work remains. This should be, in the main, handled by the Control Section mentioned above. When work is received within the department from any of the sources mentioned above, some type of project authorization form should be filled out by the office of the assistant department head. This form should contain sufficient information as to the nature of the project (such as authority, type of work, phase, if part of a larger project, provision for an estimated cost, priority, etc.) so that when it is routed to the Control Section, a control card can be set up which will be the permanent record of the job for the department. Such a card would preferably become part of a visible project control board on which schedules and costs are kept as well as completion records of the various phases. Estimated and actual costs should be carefully kept, as well as estimates or actually computed annual savings resulting from any of the projects. Where no savings are involved, (as will be the case in many service projects) this fact should be carefully noted. In this way, the department will be able to submit periodically to top management a comparative statement showing the actual costs of the various projects with the annual savings involved, segregating the service jobs for which no savings are possible.

Planning

When a project has been assigned to an engineer, the preliminary phase of the work should consist of a careful analysis, the preliminary cost estimates, and a tentative scheduling of all phases through to completion. It is realized that in some cases these schedules may have to be revised, but without such schedules, planning of the work load in the drafting room and shop, as well as for the individual engineers is well-nigh impossible. The tentative schedules should be set up on the visible control board and a record of progress carefully kept. The engineer in charge of the Control Section should keep the drafting room and shop informed as to schedules and priorities, and concern himself with those jobs which deviate from schedule (it may be noted here that it is quite as important to know what jobs are ahead of schedule, and why, as to know what jobs are behind). The Control Section should also keep a cost analysis book on which the various charges to the jobs (engineers' time, shop work, drafting, etc.) are entered as they occur. It is most advisable that each engineer receive, weekly, a list of his jobs showing either his estimate or the approved appropriation and the job cost to date. This method of keeping the individual actually authorizing expenditures as to his balance is an important factor in preventing "overruns" which must be explained. The exact method of arriving at costs and handling estimates must, of course, depend on the accounting system in use at the individual plant or office.

Manual of Organization

Thus, it will be seen that the engineer in charge of the Control Section is really the staff assistant in the Engineering Research Department, who is responsible for the gathering and dissemination of the information which makes internal co-ordination possible. This section should also be charged with the maintenance of an up-to-date manual of organization, outlining specifically and in detail all the general procedures mentioned above. This manual should contain sections relating to standard practices to be followed in: (1) making estimates, both preliminary and final, (2) writing and submitting reports—following sound engineering and scientific practice, and (3) setting up experimental programs, and (4) other procedures which lend themselves to standardization in the particular organization. These may be in greater or less detail, again depending on the particular group to which they are to be applied. There should also be maintained a job specification manual for all the jobs within the department, since the skills and aptitudes required of the engineers, draftsmen, and mechanics are likely to be different from those set up for the other departments of the enterprise.

Conclusions

The Engineering Research Department is basically a service department for the entire business. It may be said to stand in lieu of outside consultants. The organizers, directors and participants in such a department should keep this fact constantly before them, and develop a group personality based on it. In other words, the department should assume no prerogatives within the organization that an outside consulting firm would not assume. A feeling should be built up that no problem is too large or too small, so long as it is a problem, and that each problem solved improves the competitive position of the business in its industry. In this spirit, a department can be built up which will be a valuable asset to any enterprise, and by virtue of its own efforts may cause the business to grow and in so doing, will in all probability grow itself.

REPORT ON . . . . .

OXYGEN

Past, Present and Prospects

Seldom has any aspect of chemical industry aroused so much attention, so quickly or with so little factual basis, as the new postwar baby, cheap oxygen. Low purity oxygen—not the customary 99.5 percent oxygen of commerce—is the subject being discussed, with large tonnage uses possible in the oil and steel and perhaps the gas industry. Actual tests are being made or are about to commence and the situation will soon be much clearer than it is today. Meanwhile, because inter-fuel competition is becoming a much agitated subject—which depends to a large extent on cheap oxygen—additional Chemical Engineering *Reports will appear soon, dealing with both the fuel interchangeability question and with the technology of oxygen processes.*

Oxygen has always been in the air we breathe, but until recently we have seldom been acutely conscious of it. It is still in the air—but with a difference. Oxygen is being discussed throughout the chemical industry. It is being discussed in the oil industry, the gas industry, the steel industry. Oxygen has become an appropriate subject for the business page in daily papers and for large sections of the business press. Within the past year it has even "made" one of the leading national consumer magazines. Oxygen is news.

Why all this sudden interest in a chemical so well known? Why especially, when for years it has been recognized—a little wistfully—that many interesting things would come to pass "if only we had cheap oxygen"?

To get at the answer to these questions it is necessary to examine the past and present day oxygen industry and its philosophy, as well as the new factors, both technical and human, that have come into view since the war. In so doing, the reasons for the current upsurge of interest will become evident, but it will appear also that conclusions concerning the fundamental soundness of the new trends must await a vast amount of promotion, investment, construction, experiment and economic analysis. Fortunately, the new things are going to be tried. Money is already being spent; plants are being built; the talking stage is yielding to action, and the new ideas are going to have a chance to stand or fall, depending on performance.

Oxygen the Commodity

When Priestley first produced "dephlogisticated air" in 1774 by heating mercuric oxide, he had no idea either that this gas made up one-fifth of the volume of ordinary atmospheric air, or that a little more than a century later it would become the basis of a large industry. Prepared by chemical means and electrolysis, oxygen found a small use in medicine, lead burning, experimental work and for a few other purposes during the nineteenth century, but it was not until Carl von Linde and Georges Claude developed the air liquefaction and fractionation cycles that bear their names about the turn of the century that large scale use became possible. In the United States, for example, the beginning of oxygen production as an industry can be traced to the organization of The Linde Air Products Co. some 40 years ago. Linde, followed soon by others of the eventual Big Three, Air Reduction Co. and National Cylinder Gas Co., adopted the conservative policy of careful, gradual development of markets on the basis of extensive research into possible new uses, both in the laboratory and in the field. Various small producing plants came into being in subsequent years to serve small local markets, but their gross effect never represented more than a fraction of the Big Three's output, and possibly no more than about 5 percent at present.

It is evident, therefore, that the policies and practices of the industry have been those originated by the triumvirate at the top. These policies have resulted in a gradual reduction in price to a 1947 level that is only about 28 percent of that of 1921. Sharp as

Hand scarfing of steel with de-seaming blowpipe is said to have decreased steel surface conditioning costs by 50 percent compared with earlier methods

this reduction is, it still does not mean the "cheap oxygen" contemplated in the new large tonnage uses now being discussed. Instead it means high purity oxygen such as the medical, cutting and welding applications demand. In addition, it implies customer Service with a capital S, designed to produce satisfied users and also increase oxygen markets. Today's established industry is selling service as vigorously as it sells oxygen. And on the undoubted value of this service, as much as on their long background of experience in efficient separation of oxygen from air, present factors are banking to maintain the dominant position that they hold at present.

This heavy duty blowpipe makes a 30-in. cut through a 45-in. billet in 15 min.

It must be granted that there is considerable justification for the belief expressed by the Big Three that the oxygen industry is not on the verge of a revolution. Since 1907, at intervals of five or six years, the private plant idea has flared up, only to lapse again into the limbo of good ideas gone wrong. Furthermore, most of the argument for large-scale expansion in oxygen production is based on totally unproved uses for which the gas must not cost more than a small fraction of the present price.

Still, there are factors in the current flare-up, some technical or economic, some human, that differ from those of the past. Whole industries, particularly petroleum and steel, have been aroused to the possibility that oxygen may prove the answer to some of their urgent problems. Technical information coming out of Europe, especially Germany, has added fuel to the fire. The war itself has had an effect in that certain novel ideas were tried out extensively, while many people who knew nothing previously of air separation have emerged from their wartime experiences equipped with a knowledge of portable plants for military oxygen. And finally, it must be admitted that the present-day advocacy for the private oxygen plant is much superior both in quality and in persistence to that which formerly plagued the industry.

Photos on pages 124 to 127 inclusive courtesy of The Linde Air Products Co., New York

That much the present producers will grant. In addition, it is obvious that they are watching the portents closely, ready to leap in and carry the ball should the game threaten to get out of hand. In fact, in at least one case, a Big Three member is already carrying the ball in an effort to help the steel industry decide the moot question of oxygen in the open hearth.

High Purity Oxygen

At the outset, it must be emphasized that the oxygen being discussed for the new large tonnage uses is, in the main, not the same product that the established industry has been selling along with its service. Heretofore commercial oxygen has meant 99.5 percent O_2, a high purity product that is necessary for most of the customary uses. Tonnage oxygen for petroleum, steel and gas industries need not, it is felt, contain more than 88 to 98 percent O_2. Oxygen in the range from 90 to 95 percent is most often meant when "cheap oxygen" is discussed, and it is obvious from a consideration of physical principles involved in separation that a low purity product can be considerably less costly. It is also likely from a consideration of present uses that not much competition is to be expected between the high and low purity products. Oxygen of 99.5 percent will continue to hold most of its present markets, while the tonnage uses, if they materialize, will be at least as well served with a lower purity gas.

A quick picture of present oxygen uses and usages is desirable before we proceed to a discussion of new factors. Oxygen, now perhaps about to enter its third phase as a tool of industry, passed through two earlier phases punctuated by the conclusions of the two World Wars. After the first World War, its earlier maintenance users were supplemented and eventually far outstripped by uses as a production tool. Following the second World War, the big ques-

Table I—U. S. Production of High Purity Oxygen in Commercial Plants
(Source, U. S. Census)

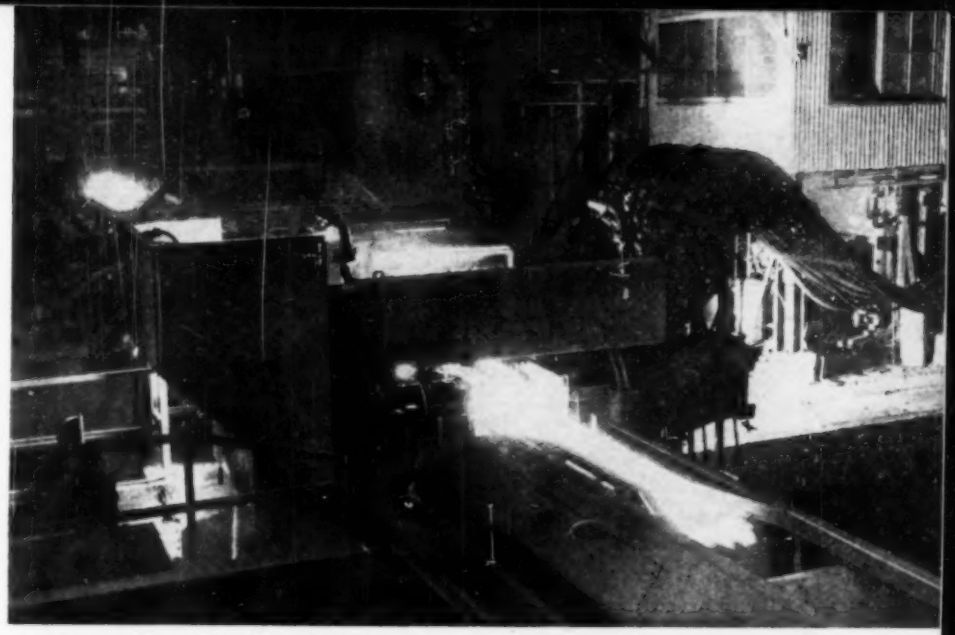
	Total Production, 1,000 Cu.Ft.
1929 [1]	3,140,095
1933 [1]	1,821,880
1935 [1]	2,683,859
1937 [1]	4,441,391
1939 [1]	4,561,968
1941	8,661,561
1942	12,874,277
1943	16,572,962
1944	18,743,087
1945	13,925,977
1946 [2, 3] (est.)	11,000,000

[1] Prior to 1941 figures do not include oxygen made and consumed in producing plants, estimated to average 3 percent. [2] Estimated on 8,832,715 M cu.ft. for 10 months. [3] 228 plants in 37 states.

Table II—Percentage Breakdown of Present Oxygen Usage by Industries

(Estimated by The Linde Air Products Co.)

	Sub Total, Percent	Total, Percent
Steel Industry		40
Machine scarfing	6.5	
Hand scarfing	23.0	
Other production	8.5	
Maintenance	2.0	
Steel Fabrication		25
Plate edge preparation	7.5	
Other cutting	15.0	
Welding	2.5	
Industrial Maintenance		8
Miscellaneous Uses		
Scrap iron production		6
Chemicals and petroleum		5
Automotive and aircraft		4
Medical and breathing oxygen		3
Other industries		9
All uses		100



Machine scarfing of steel is not as large an oxygen user as hand scarfing; this metal conditioning machine scarfs four sides of a bloom at 125 ft. per min.

tion is whether its application as a chemical raw material may not far outstrip the maintenance and mechanical type uses in production.

As noted, prior to World War I, oxygen's usage, tonnage-wise, was chiefly in maintenance. The oxy-acetylene welding torch was the principal agent of its use, but this tool had not yet gained importance as a fabrication instrument. The cutting torch, too, had emerged but again it was relatively crude, more useful for the dismantling of old structures than for the shaping of metal parts. Then in the period of the 20's, modern techniques in fabrication with oxygen began to take form. The welding torch became a construction tool. Although it later lost ground to the electric arc in this field, it should be noted that the arc gained only relatively. The welding torch has never receded absolutely since there has been a continued increase in oxygen used for this purpose.

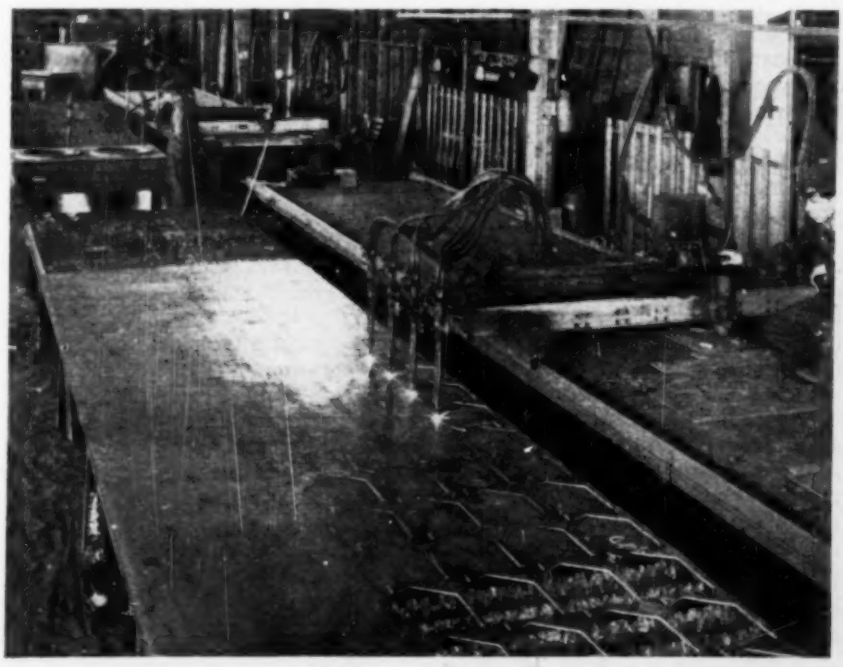
The big increase in oxygen use came in the steel industry for cutting purposes, where numerous highly developed methods eliminated millions of man-hours in handling scrap, tapping furnaces, splitting ingots, removing defects by hand or machine scarfing between rolling operations, and finally in cutting up the mill's products. The metal fabrication industry also took to cutting as a rapid substitute for sawing and shearing, and even for machining. Flame hardening and flame de-scaling operations came into the picture and oxygen consumption soared, as Table I indicates. Most of these techniques were highly developed at the outbreak of World War II, enabling oxygen to play a part of tremendous importance in the production of ships and weapons. By the war's end, the oxygen industry included not only the Big Three, but also 33 independent producers. For 1943 the Census listed a total of 228 producing plants in 37 states.

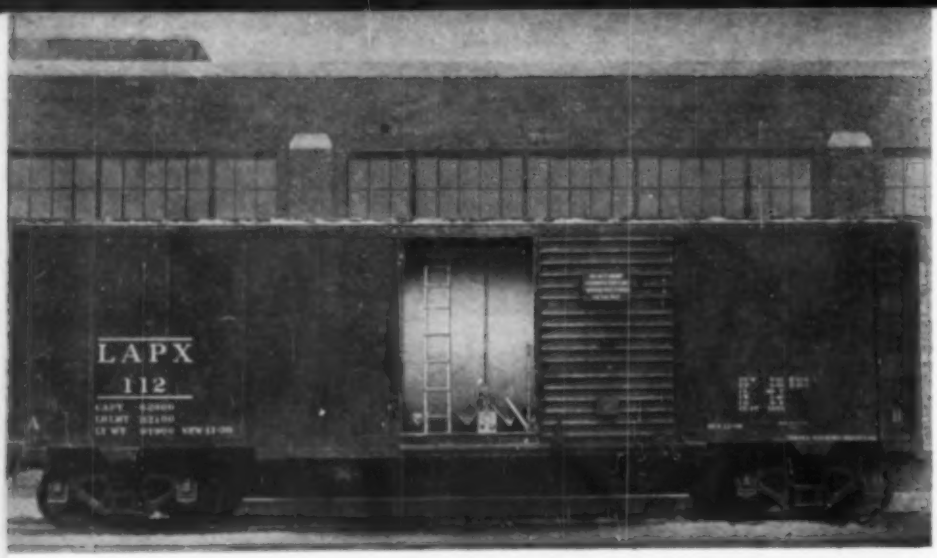
One phase of wartime oxygen, however, was not reflected by the Census. Although arsenals and Navy Yards were able to secure their gas requirements from members of the industry, far-flung repair depots could not, and it became necessary for the military to provide oxygen where and as needed. In addition to repair, the armed forces required relatively enormous quantities for the personnel of high-flying bombers and fighters. Light-weight portable plants were therefore developed, both by members of the industry and by outside engineers and equipment manufacturers, and were shipped literally by the hundreds to all corners of the earth. Although economy was secondary in these small plants, they incorporated novel ideas that appear in some of today's new oxygen plant designs. Of them more later as the current picture is developed.

Oxygen Distribution

How to transport oxygen from point of production to point of use has al-

Flame cutting is one of the largest oxygen uses; here four torches follow a template simultaneously to make smooth cuts in a piece of steel plate





To meet heavy steel industry demands, Linde developed this special box tank car for liquid oxygen; each car carries 62,000 lb., equivalent to 750,000 cu. ft.

ways been one of the serious problems of the industry, and one that undoubtedly has been a deterrent to wider application. In the early 30's shipment was entirely in standard steel cylinders of two sizes, holding, respectively, 110 and 220 cu.ft. of gas (expressed at standard temperature and pressure). In spite of the use of a 2,000 lb. or higher storage pressure, it was possible to cram only about 18 lb. of gas into the 125 lb. larger cylinder which meant the two-way shipment of over 7 lb. of container for every pound of gas transported in one direction. Oxygen's low atmospheric boiling point of −297 deg. F. made it impossible to transport bulk quantities of liquefied gas without heavy insulation and appreciable gas losses. For a long time, therefore, no serious attempt at bulk shipment was made. However, as individual users in the steel industry began to take quantities that were impractical for handling in small cylinders, bulk methods became imperative.

Two such methods came into use. One was to employ 30,000 lb. truck trailers carrying multiple high-pressure vessels holding about 3,000 lb. of gas. The other was the shipment of liquid oxygen at substantially atmospheric pressure.

The latter method, although it offered problems of its own, immediately made long distance transport of large tonnages not only possible but practical. In 1932 Linde commenced shipment of liquid oxygen in giant "Dewar bottles"—insulated non-pressure vessels carried either in a boxcar or on a motor truck. At atmospheric pressure a cubic foot of liquid oxygen is equivalent to 863 cu.ft. of standard gas so that an oxygen tank car is able to deliver at a clip 62,000 lb. of liquid, equivalent to about 750,000 cu.ft. of gas, the equal of over 3,000 cylinders, or 11 freight car loads!

To match this delivery, the company installed insulated storage tanks at users' plants, provided with vaporizing equipment to deliver gas direct to the users' pipelines. "Ballast" reservoirs were provided to store the normal evaporation at about 150 psi. ga. The method neatly eased the transportation problem and in at least one case averted the need for a new wartime oxygen plant at a time when equipment was all but unobtainable.

Liquid oxygen in transit suffers from a nominal loss. Practically all evaporation must be valved, since the liquid can be stored in large vessels under nominal pressures only. In fact, oxygen has a critical temperature of −182 deg. F. so that even a corresponding pressure of 50 atm. cannot maintain liquid at higher temperatures. Since it has not proved practical to store the liquid under refrigeration, good insulation must be relied upon to minimize the loss of gas. Practice, therefore, has been for the producer to retain title to the liquid until it has been vaporized into the consumer's line. The latter therefore pays only for the oxygen he actually uses.

Current Picture

This, then, is the screen against which today's oxygen picture must be projected. The picture is hazy for it contains many conjectures. Some have attempted to fill in its details by arguments from German experience, while others point to the fact that Germany, owing to the unnatural wartime economy into which Hitler forced the country in 1933, does not offer parallels for a free economy such as ours. The fact remains that engineers in several industries have long recognized the theoretical advantages that cheap oxygen—or at least a cheap enriched air—would bring to their own particular operations.

For example, the gas industry could use oxygen to permit continuous operation of the water gas reaction—rather than the present intermittent "blow" and "make" cycle—which would result in a greater capacity for gas than the latter. There is also the possibility of complete gasification of coal, which some believe will give consequent savings in both operating and investment costs. In the steel industry, the higher temperatures resulting from an oxygen-enriched blast have been recognized to offer the possibility of a shorter cycle in the open hearth furnace, possible improvement in the bessemer converter cycle, and perhaps also improved blast furnace economy and even direct production of steel.

In addition, chemical manufactures have appreciated the opportunity that cheap oxygen would offer in the production of synthesis gases for a wide variety of synthetic organic products, including liquid fuels.

There was, unfortunately, no cheap oxygen. Little effort apparently was made previously in the United States to explore the economics of producing a low purity oxygen for chemical purposes and relatively low temperature combustion processes, as distinguished from the high purity article of commerce that is essential for high temperature welding and cutting torches. Although it was clear that a low purity oxygen could be separated from air at much lower cost, the right combination of economic conditions and demand had not occurred to induce its production. With only a very minor percentage of all oxygen produced privately, large purchasers paid in the neighborhood of $3 for 1,000 cu.ft. of 99.5 percent O_2, while the price might be as high as $20 per 1,000 cu.ft. for a small user.

It seems likely that these prices were not out of line, considering first the fact that the cost of pure oxygen separation is much higher in small than in very large units, and second, that the user secured a large measure of real service with his purchase.

There is little evidence available to show at what cost a private plant might be able to produce its own high purity oxygen. If the power consumption be taken as a criterion, it appears that the power per unit of production may be almost three times as great in a very small plant as in a large plant. Nevertheless power cost is a much less important factor in the total in a small than in a very large plant. Furthermore, large plants are generally equipped for the recovery of argon, neon and sometimes krypton, helium and xenon. Hence the economics is highly complex. Perhaps the best evidence is the offer of one plant builder to save users at least 30

percent by employment of leased plants installed on users' premises and operated by the user. To a large extent such savings result from the elimination of distribution costs.

However, today the woods are full of estimates for cost of low purity oxygen, in the range from 88 to 98 percent. Allowing no cost for available byproduct heat (although the cost of converting this heat into power is included), one engineering firm estimates 4.8 c. for 1,000 cu.ft. of 95 percent O_2 in a plant of 48,000,000 cu.ft. per day capacity. It should be emphasized that such a plant is by far the largest ever built and that it has, indeed, not yet been built. Other estimates which include all factors in power cost range from 10 c. to 18 c. per 1,000 cu.ft. of low purity gas. If 12 c. be taken as a fair average for large users, the figure is only about 4 percent of the present cost of high purity gas to such users, which immediately opens attractive potentialities. It is clear that if such costs can actually be attained, then the theoretical advantages of oxygen use are due for some real exploration.

German Oxygen

German experience may not count for a great deal when extrapolated to our own industrial frame, but it is at least of some interest. Two primary needs brought about widespread oxygen use in the German steel, chemical and gas industries. The first was the problem of low-grade coals, the second the urge to get all possible production out of existing equipment.

Insufficient coking coals were available to Germany to meet all demands and it was necessary to make use also of local sub-bituminous brown coals (high-grade peats). A producer-gas reaction applied to direct gasification or gasification of the low-temperature, high-ash chars produced from such coals gave a low B.t.u. gas that could be materially improved by employing a continuous enriched air-steam blast. Such gas served both for fuel and for chemical purposes. Germany developed a number of novel water gas generators, some using coal, some coke, some for oxygen blast, others for air. A type of fluidized fuel bed was used in one, while another operated under a pressure of 20 to 30 atm. to emphasize methane production and eliminate subsequent gas compression. Still others operated at such high temperatures that the ash was removed as molten slag. The evaluation of these various gas producers is now being carried out by gas industry specialists of several Allied countries.

Although much has been said about German use of the Fischer-Tropsch process for liquid fuel synthesis, actually this method at its peak produced less than 8 percent of the country's annual output, the lion's share or 40 percent (1940-1944 avg.) having been made by the hydrogenation process. Most of the Fischer-Tropsch plants used a conventional water gas process based on coke-air-steam for their synthesis gas, only two of the nine plants using brown coal and oxygen.

Germany's steel industry also resorted to oxygen, largely to increase production. The results appear not to have been particularly conclusive. Strangely enough, little if any use was made of oxygen in the open-hearth furnace, which is considered the most likely application in the United States. Instead, it was tried in the basic bessemer converter, giving so short a cycle as to make control difficult, and in the blast furnace, where trouble was experienced with refractories at the high prevailing temperatures. After a variety of efforts to keep the temperature down, the process was finally abandoned.

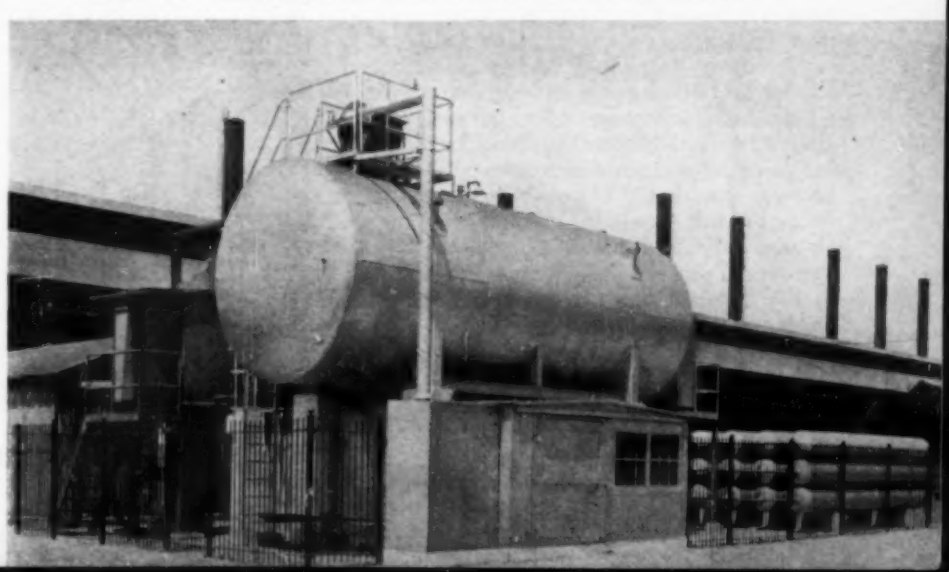
Even under its controlled economy, Germany probably could not have turned to oxygen enrichment had it not been for the availability of a low-cost, low-purity oxygen process, the Linde-Fränkl, devised by Mathias Fränkl in 1932. This process, which was used extensively and will be described briefly at a later point, reduced chemical costs sharply, operated at a very low pressure on most of the air treated, and according to Ruhemann ("The Separation of Gases," Oxford, 1940) produced 98 percent O_2 in a rather large plant for 1.53 pfennigs per cubic meter (approximately 10 c. per 1,000 cu.ft.). Of the total, power cost amounted to 58.8 percent; depreciation to 31.4; wages to 4.9; and water, lubricating oil and chemicals to 4.9 percent. However, the investment against which depreciation was figured seems to have been exceptionally low by present day U. S. standards. Furthermore, nothing was included for interest on the investment.

Portable Plants

While the Germans were having their wartime experiences with low purity oxygen, the United States was accumulating experience of another kind with the high purity product. It has already been mentioned that military demands at remote points forced the development of a number of small portable units, some of which were rather conventional in cycle, while others incorporated novel ideas. All, of course, employed novel ideas in achieving portability. Among these may be mentioned the units developed by Air Products, Inc., Independent Engineering Co., Linde Air Products, E. B. Badger & Sons, and M. W. Kellogg Co. in conjunction with Clark Bros. Co. The first of these units employed basically a simple Linde type cycle with Freon refrigeration supplementing compression, to which an ingenious liquid oxygen pump was added, permitting direct pressure charging of the gasified oxygen into cylinders without the use of an oxygen compressor. The second employed 800 lb. pressure and secured its refrigeration by means of an expansion engine working on a part of the high pressure air in a manner similar to some of the Claude cycles, discharging gaseous oxygen to an oxygen compressor.

The last mentioned type did not reach completion in time for extensive use, but incorporated the most unusual cycle. Several of the designs now being actively promoted for heavy tonnage oxygen are based on similar ideas so that this type requires a more lengthy description.

This liquid oxygen storage tank at a user's plant holds the equivalent of 12,250 cu. ft. of gas; the multiple cylinders at the rear receive the evaporated gas



Owing to the difficulty of securing high pressure compressors during the war, it was felt by the National Defense Research Committee that a low pressure unit was desirable. M. W. Kellogg Co., having some familiarity with the Linde-Fränkl cycle, was assigned the task of developing such a unit. In this work the company received the assistance of Clark Bros. Co. in various phases of mechanical design and of Prof. S. C. Collins at M.I.T. who had already worked out a novel type of reversing triple-pipe heat exchanger for oxygen production (*Chem. Eng.*, Dec. 1946, p. 106). Profs. F. G. Keyes at M. I. T., B. F. Dodge at Yale and J. G. Aston at Penn State all contributed toward the heat exchange and cycle problems.

Linde-Fränkl Factors

At the outset it was recognized that the principal feature of the Linde-Fränkl cycle, namely, its use of two pairs of regenerators known as "cold accumulators" instead of the usual heat exchangers, inherently prevented production of the necessary high oxygen purity. A pair of Fränkl metal-packed accumulators is first cooled by the leaving streams of oxygen and nitrogen, after which the entering air is switched through them, inevitably contaminating the oxygen on the next cooling cycle. However, the accumulators had one very desirable feature, that of removing moisture and carbon dioxide with only a minimum need for drying chemicals. They performed this function by freezing out from the incoming air first the water vapor, then the carbon dioxide, which were re-evaporated from the accumulators on the next outgoing gas cycle.

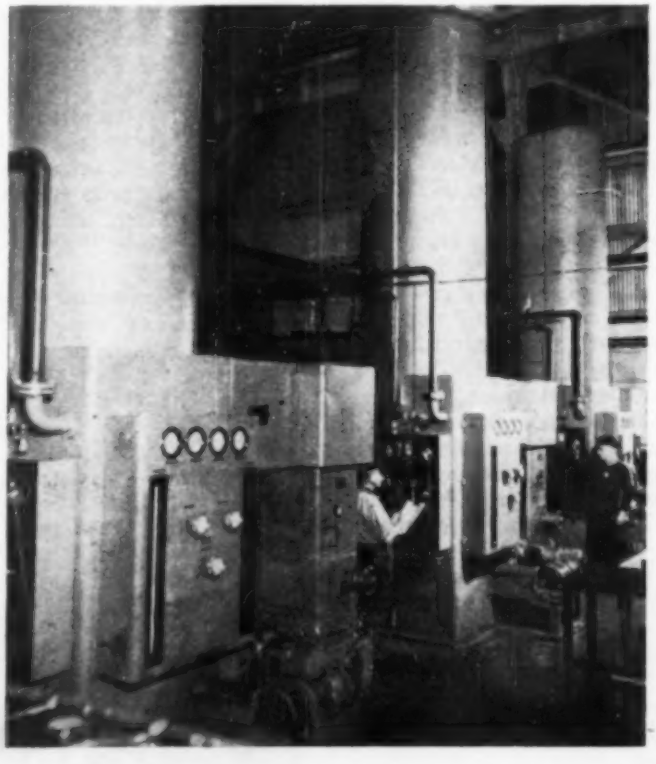
Fortunately, it was possible by a somewhat more complex arrangement to secure the purification feature of the accumulators, without contamination of the pure oxygen stream. Here is where a reversing exchanger of the type advocated by Prof. Collins fitted into the flowsheet. In its simplest form this device was a concentric triple-pipe exchanger containing extended surface in the two annuli and hooked up with reversing valves so that, whereas the outgoing pure oxygen always followed the central tube, the incoming air and waste nitrogen could be made periodically to swap paths between the two annuli. At all times the air would be cooled in heating both the oxygen and nitrogen streams, but in the first half of its cycle it would be dropping water and carbon dioxide ice in the inner annulus, in the latter half, in the outer annulus. Meanwhile, the nitrogen would be re-evaporating the previously deposited ice from its own passageway, and carrying it to waste in the atmosphere. No chemical purification was required although it was necessary occasionally to thaw out the equipment to remove unevaporated impurities.

As built by Clark Bros. Co., this unit, the Army's M-7, employed a number of features developed by Clark, including a special reciprocating expansion engine with ringless pistons, which provided the refrigeration by expanding a part of the 80-lb. high pressure air; and a dry carbon-ring oxygen compressor which solved the problem of lubricant contamination of the oxygen. This was extremely important, of course, not alone because of the explosion hazard, but also because the oxygen was largely destined for breathing by high-altitude flyers. The unit successfully combined the best features of the Linde-Fränkl cycle with ability to produce oxygen of purity in excess of 99.5 percent. There was, of course, a considerable loss of oxygen in the waste nitrogen stream at high, as compared with lower, purities. For example, at 99.7 percent O_2 the efficiency with respect to oxygen in the product, in relation to oxygen in the feed, was reported at 46 percent, compared with about 55 percent at 98 percent purity. A much higher oxygen efficiency would be secured in a larger plant employing a double rather than a single fractionating column and designed for economy rather than portability.

Who's Who in Oxygen

In addition to the concerns already mentioned, there were others that secured oxygen experience during the war. Most of them are still interested. P. C. Keith envisioned possibilities for cheap oxygen in conjunction with a Fischer-Tropsch type of synthesis employing natural gas as the raw material, and organized Hydrocarbon Research, Inc., which has now developed such a process through a small pilot plant stage. The Elliott Co., called on by the OSRD to design a turbine type expander comparable to those developed in Germany by the German Linde Co. and in Russia by P. Kapitza, worked out such a design in collaboration with the Sharples Corp., and has since become interested in oxygen cycles. This company is rumored to be in the pilot plant stage with a unit designed to appeal to the steel industry. Arthur D. Little, Inc., also was associated with some of the wartime research, and at present is concerned with both oxygen plants and those for the separation of other gases such as helium. The Little organization is reported to be working with Prof. Collins. Of the old-line United States oxygen producers, both Linde

Here are three of the four oxygen units installed by Air Products, Inc., in the plant of a large steel concern



and Air Reduction have been watching the performance of the Linde-Fränkl cycle since its development, although neither has used it so far. However, Air Reduction and the Koppers Co., have recently announced an experimental program in conjunction with Bethlehem Steel, involving two 70 ton per day units for 88-90 percent O_2, using a modification of this cycle.

Oxygen Cycles

Oxygen is produced by three fundamentally different methods. The first two, electrolysis and absorption, are of little interest from a large tonnage standpoint. Electrolysis of water has been used for many years in a few locations where power was cheap and hydrogen was desired as the primary product. However, power requirements are much greater, amounting according to L. L. Newman (1946 Report of A.G.A. Gas Production Committee) to at least 250 kw.-hr. per 1,000 cu.ft. O_2, compared with 12.7 to 48.3 kw.-hr., depending on plant size (Ruhemann, *vide supra*) for fractionation processes. There is, of course, a credit for twice the volume of hydrogen. If this gas be included at its equivalent value in terms of water gas, Newman calculates the power consumption for oxygen as still amounting to 167 kw.-hr. per 1,000 cu.ft., a figure that indicates little interest for electrolysis except under special circumstances.

Absorption processes, likewise, exhibit extremely high cost. Under OSRD sponsorship, considerable work on the chelate group of regenerable organic oxygen absorbers was carried out during the war (e.g., OSRD Report 3359). "Salcomine," which is cobalt disalicylal ethylene diamine, will absorb from 2 to 4 percent of its weight of oxygen in each cycle, depending on the degree of its progressive deterioration in use, but the material is expensive and short lived (Newman, *loc. cit.*) and results in a chemical cost alone about four times the probable value of the oxygen. It too at the present state of the art can probably be ruled out except under special circumstances.

Processes depending on liquefaction and subsequent fractionation are the ones on which the great bulk of oxygen production will depend. Numerous cycles have been developed, their complexity varying markedly depending on the completeness of separation and the approach to theoretical efficiency that is desired. These cycles will be the subject of a separate *Chemical Engineering* Report (to appear in an early issue) and it will not be possible here to go into the theory of air separation or the details of cycles other than to mention that most of those now in use are based on either the cycle developed by von Linde in 1895, or Georges Claude's cycle of 1902. Both cycles operated at relatively high pressure. The principal difference lay in the method of producing the necessary refrigeration for air liquefaction. Simple Linde cycles produce all the required refrigeration by throttling of the high pressure air while more complex cycles frequently superimpose an ammonia refrigeration cycle. The Claude system, however, achieved its refrigeration by the more or less isentropic expansion of a part of the compressed air in a reciprocating engine which was made to do work and thus produce more refrigeration of the expanded air than could be secured by throttling alone. The remainder of the air in a Claude cycle was, however, throttled.

In addition to these well known classes of cycles, there are two others, the Heylandt which combines features of both the Linde and the Claude cycles to produce a flowsheet requiring exceptionally small power consumption; and the cascade type, a cycle which involves considerable complexity for a probably theoretical advantage.

For details of the state of development of these cycles, and for the fundamental theory, the best of present references is "The Separation of Gases," by M. Ruhemann, Clarendon Press, Oxford (1940, revised slightly in 1945).

Where New Uses Stand

Three types of cheap oxygen use are currently being discussed at length, while a few others, such as in copper converters and cement kilns, seem to be receiving a little consideration. The principal uses include hydrocarbon syntheses, steel industry and gas industry applications. The first two are being agitated much more vigorously than the last.

Hydrocarbon Synthesis—Since 1928 the U. S. Bureau of Mines has been engaged in a long range program of investigating methods to supplement present petroleum resources. With coal our primary raw material, these methods have hinged mainly on coal hydrogenation and syntheses of the Fischer-Tropsch type from coal-produced water-gas. Indicated costs in the range of 16-18 c. per gal. for gasoline have obviously been uneconomic under present conditions in the United States.

The petroleum industry, however, has been watching the German experience closely, particularly synthetic processes. It is difficult to say how far the industry's present accelerated interest may have developed spontaneously, or to what extent it may have been catalyzed by Hydrocarbon Research, Inc. At any rate, at least three Fischer-Tropsch plants are now definitely in the cards, and others are rumored. Hydrocarbon Research is the designer of two of these plants, while Standard Oil Co. of New Jersey is reported to have a pilot plant in operation and is believed to be approaching the design stage on a process of its own. Gulf Oil and others are also being mentioned.

A group including the Texas Co. and seven other concerns is behind the first plant, that of Carthage Hydrocol, Inc., which is expected to be completed early in 1948 at Brownsville, Tex., at a total cost estimated at about $16,000,000. This plant, designed by Hydrocarbon Research, will be erected by Arthur G. McKee & Co., of Cleveland. It will include an oxygen plant comprising two parallel units and is rated to produce about 48,000,000 cu.ft. per day of 95 percent oxygen in two units. This oxygen will then be used in the partial oxidation of 68,000,000 cu.ft. of 1,000 B.t.u. natural gas, from which an estimated 5,800 bbl. of 80 octane gasoline, 1,200 bbl. of diesel oil and 150,000 lb. of crude alcohols per day will be made. Including capital costs, with gas at 5c. per M, the gasoline is estimated to cost 5¼c. per gal., which compares favorably with the present Gulf Coast wholesale price of 7¼c. per gal.

The oxygen plant, which is included in the total plant cost at $3,500,000, is designed to operate at a low pressure of about 75 psi. ga., using a new design of reversing exchanger in conjunction with centrifugal expanders that will provide all necessary refrigeration. The plant's centrifugal compressors are expected to handle about 250,000,000 cu.ft. of air per day with an oxygen recovery of over 90 percent and an estimated cost of 4.8c. per 1,000 cu.ft. of 95 percent of O_2, not including the fuel value of waste heat and certain byproduct purge gases obtainable from the synthesis process. Operating and capital costs on the production of power from this waste heat for the oxygen plant, as well as for synthesis plant power services, are included at 12½ percent for depreciation as well as 5 percent for interest on the investment.

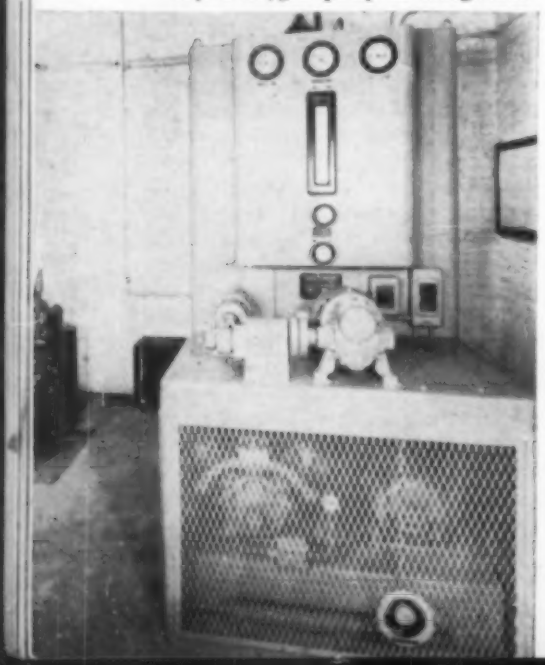
The plant is expected to be in substantial energy balance, with all power requirements supplied by the waste heat available from the synthesis gas production and the catalytic Fischer-

Tropsch reaction. Incidentally, Hydrocarbon Research intends to concentrate its activities mainly on processes of this type involving integration of oxygen production with other processes where waste heat is available to provide at least the greater part of the power requirement.

Standard Oil Co. of Indiana is behind the second plant, to be built in the Hugoton, Kas., field, perhaps in 1948. The plant is expected to be of the same size and general type as the Hydrocol plant and is to be designed by Hydrocarbon Research, but constructed by M. W. Kellogg Co. The low production cost anticipated for both plants, compared with German synthetic fuel costs, is traced to superior design, largely through the substitution of fluid catalyst reactors and an improved iron catalyst for the small fixed-bed cobalt catalyst reactors of German practice. An interesting extension of the fluidization principle that is being investigated by Hydrocarbon Research is the possibility of making synthesis gas direct from coal rather than from natural gas, using a fluid bed type of water-gas reactor. The opinion is voiced that such a process may be feasible within two or three years and that costs may not be much higher than with natural gas. Gas industry engineers have criticized the figures, however, as not allowing sufficient cost for coal gasification.

Steel Industry—No estimate is available of possible oxygen uses in the steel industry if application in the blast furnace and bessemer, as well as in the open hearth furnace, should all prove feasible. Suffice it to say that the total would be extremely large. Many steel concerns are actively experimenting, or preparing to do so, and such organizations in the oxygen field as Air Reduction and Koppers, Air Products, Inc., Stacey-Dresser Engineering, and the Elliott Co. are actively engaged in promoting the idea. Air Products has installed on lease four units for one large steel company (illustrated on p. 128) and is now prepared to supply plants ranging from 2,000 tons (47,500,000 cu.ft.) per day, down to 200 cu.ft. per hour. Over 20 plants have been contracted for in this country or abroad since Air Products started to undertake private business last May. In the negotiation or discussion stage are units for several other steel and petroleum companies. Plants built by this concern are sold abroad, but leased to operators in the United States.

Small Air Products oxygen unit, showing liquid oxygen pump in foreground



Plans for Steel

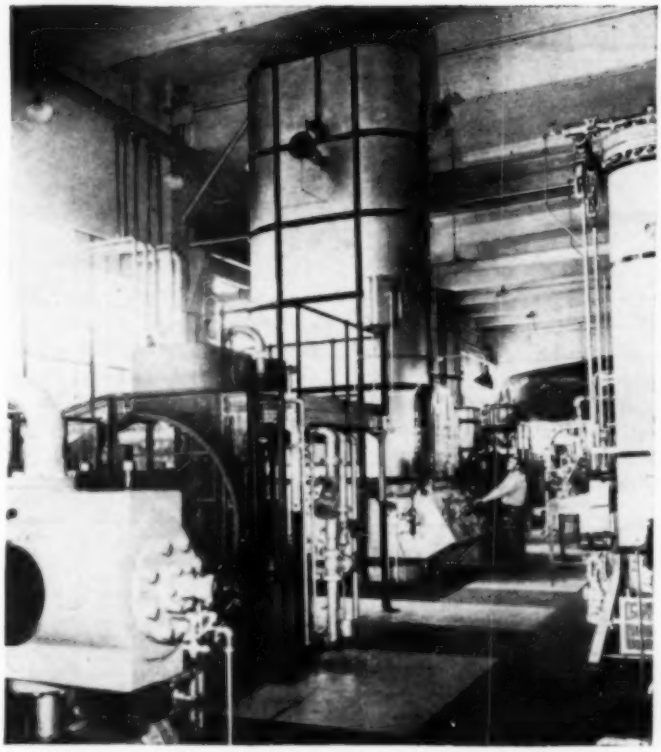
So far no steel company has acquired ownership of an oxygen plant. Except for one mentioned, other experimenters have been using comparatively small quantities of purchased high-purity oxygen. Bethlehem Steel has arranged with Air Reduction, in collaboration with the Koppers Co., for the construction of two 70-ton-per-day units at Johnstown, Pa., which are to be owned and operated by Air Reduction and will produce low purity gas for both open hearth work and blast furnace experimentation. However, Jones & Laughlin has been reported to be planning expenditures of $40,000,000 in the next four or five years for new open hearth furnaces, plus an oxygen plant large enough to supply enriched air to all furnaces. For this purpose, it has been estimated that a fair-sized mill will require as much as 10,000,000 cu.ft. per day of oxygen, which, although not large in comparison with the proposed oil industry plants, still amounts to something like one-fifth the total U. S. daily production (of high purity gas) in the previous peak year of 1944.

In Ohio alone, 12 open hearth furnaces were reported experimenting with oxygen during November 1946. Various results have been achieved, but the general experience indicates savings in the overall cycle time from 20 or 30 to as much as 50 percent. Balanced against such a capacity increase, however, is the possibility that modification of the furnaces or at least of the burners may be desirable.

Oxygen enrichment was first tried in Belgium in 1913, in both the open hearth and the blast furnace. In the open hearth it can be used to shorten materially the charging and melting down period because temperatures are lower than during the finishing operation and refractories will not be damaged. There appears to be some acceleration of decarbonizing also. The case for the blast furnace is less clear, however, since refractories damage seems to have been a common experience. On careful tests conducted in an open hearth furnace at Hamilton, Ont., by the Steel Co. of Canada, during the spring of 1946 (*Steel*, Dec. 1946, p. 106) it was found that capacity increases of 20-40 percent were possible. Out of a 10- or 11-hour cycle in a 200-ton furnace using 50 percent scrap and 50 percent hot metal, some 8 or 9 hours is consumed in charging and melting down. The fuel rate normally is about 400 g.p.h. of oil, burned with 11,000 cfm. of air. But by using 1,000 cfm. of oxygen mixed with the same air flow, and 600 gph. of oil until the the hot metal addition is started after three or four hours, the charging and melting down time can be decreased one to three hours, without raising the refractory temperature as high as the usual 3,000 deg. F. finish. With 10 percent excess air and 2 percent O_2 in the flue gas, the 50 percent greater fuel rate requires only a 13 percent increase in waste gas volume. Oil consumption per pound of metal is reduced 8 percent, the cycle is shortened 20 percent or more and the control of flame characteristics and distribution is much improved. Although 99.5 percent O_2 was used in these tests, it is indicated that 90 percent O_2 will be satisfactory.

Tests so far seem to show that the greatest advantage will be obtained in furnaces where present fuel burning capacity and waste gas handling facilities are limited. However, it is believed that the economic justification will depend to a large extent on the conditions peculiar to a particular plant.

Gas Industry—Possibilities for oxygen use in the gas industry meet with a mixed reception on the part of gas men, many of whom feel that the industry cannot justify the heavy investment in oxygen equipment in competition with natural gas, and that what the industry needs is not more expensive, but rather lower cost equipment for peak load supply. Those who favor oxygen experimentation, however, feel that direct gasification should be considered as a base load, rather than a peak load proposition. German experience, it is argued, cannot be construed as favoring oxygen use in the United States, owing to differences in coal. The gas industry is conducting experimental work at the Institute of Gas Technology, and it appears likely that some form of relatively expensive two-stage gasification would be necessary for our own bituminous coals



Column and other operating equipment in one of Air Reduction Co.'s plants where high purity oxygen is produced

which tend to soften and cake under the influence of high-temperature oxygen gasification. It is interesting to note, however, that the anthracite coal industry is considering a research program on anthracite gasification which it is believed could be handled in the fluidized state with no more trouble than the German coals give.

The possibilities for synthesis gas from coal may not be as bright as those for city gas in the opinion of U. S. Bureau of Mines men who have as yet not been satisfied that a cheap process can be found. Furthermore, it is also pointed out that coal gasification leads to the presence of both hydrocarbons and sulphur in the synthesis gas, which would act as catalyst poisons. In comparison with natural gas, as a fuel for synthesis gas, coal appears unfavorable also from a cost standpoint. For example, to secure 1,000,000 B.t.u. in synthesis gas from coal requires about 100 lb. of coal at a high conversion efficiency of 80 percent. At $4 per ton delivered, this coal would be worth 20c., while the oxygen to gasify it would cost in the neighborhood of 6c. (at 12 c. per 1,000 cu.ft.). Conversion would add perhaps 5c. more, all costs included. The total of 31 c. is high in comparison with the cost of 1,000,000 B.t.u. in natural gas which, in Texas, can be secured for as little as 5c. per 1,000,000 B.t.u., or in Pennsylvania for 20c. Even at $2 for coal, a mine-mouth cost, the synthesis gas cost would approximate 21c. This analysis, it is to be noted, has not attempted to take into consideration possible increases in coal cost resulting from the forthcoming wage negotiations.

Another possibility for oxygen in gasification is about to be explored in a joint effort of the Alabama Power Co., and the U. S. Bureau of Mines. A 3-ft. seam in the company's Gorgas, Ala., mine is to be gasified underground by an enriched air blast in a manner similar to that employed since 1935 at several operations in Russia. Russian experience using both atmospheric and enriched air shows that, even with oxygen, the maximum calorific value of gas so far produced, 191 B.t.u. per cu.ft., is much too low for pipeline transmission. Owing to the numerous difficulties encountered the Russian experience does not appear to have been entirely satisfactory. However, this method has managed to multiply Russian labor efficiency in the mines by about 500 percent in the most successful underground gasification experiments, but in so doing this efficiency has been brought only to as high a level as in present mechanized U. S. coal mining operations. This expedient may be of some interest in otherwise unmineable seams in the United States, but it is not likely otherwise to cut much of a figure.

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Retrospect

To conclude this survey and summarize a few of the principle points that have been raised, it seems that today's "cheap oxygen flurry" has a much more substantial base than other flurries which periodically have preceded it. Furthermore, there is a likelihood that low purity oxygen can be produced for a small fraction of the present cost of high purity gas, provided it is made in large units operated at substantially constant rate and installed at the point of use. Assuming then that this is the case, it remains for cheap oxygen to make good from both economic and technical standpoints in a variety of applications that have been demarcated for it.

Both the petroleum and the steel industries are actively going ahead to determine whether the gas can make good. In at least three plants based on a Fischer-Tropsch type of synthesis, its use is going to be tested in competition with liquid fuels derived from petroleum. In the steel industry its application in the open hearth furnace has already been found technically feasible, but the economic justification requires further proof. Neither technical nor economic feasibility has been proven for oxygen in the blast furnace, but this application too is expected to receive a fair trial in the near future.

Probably the case for cheap oxygen in coal gasification is not as good as in the oil and steel industries. Already a small amount of work is being carried out to prove the technical interchangeability, through oxygen gasification, of coal and natural gas. The question of economic interchangeability will still remain, however, probably to be answered by transportation costs rather than anything inherent in the technology.

So far as high purity oxygen is concerned, its uses will doubtless continue their orderly expansion, still led by the Big Three. Some private plant construction is not unlikely, of course, nor is it impossible that prices may thus be somewhat reduced. However, emphasis in current agitation is mainly on the low purity product. The business in oxygen of 99.5 percent purity may well be largely unaffected by anything now visible on the industrial horizon.

PLANT NOTEBOOK

Theodore R. Olive, ASSOCIATE EDITOR

$50 CASH PRIZE FOR A GOOD IDEA!

The editors of Chemical Engineering *will award $50 in cash each month to the author of the best short article received that month and accepted for publication in this department. Each month's winner will be announced in the issue of the next month and his article published in the month following. Judges will be the editors of* Chemical Engineering. *Non-winning articles submitted for this contest will be published if acceptable, and paid for at space rates.*

Any reader of Chemical Engineering, *other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are considered, in making the award.*

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, Chemical Engineering, *330 West 42nd St., New York 18, N. Y.*

DECEMBER WINNER

A Prize of $50 in cash will be issued to

GERALD V. O'CONNOR

Evans Chemetics, Inc., Waterloo, N. Y.

For his second winning of this contest (September winner also). His article deals with a siphon-proof automatic separator for immiscible liquids

This article will appear in our February issue. Watch for it!

November Contest Prize Winner

AUTOMATIC REFLUX CONTROL AND TIMER FOR PILOT PLANT DISTILLATIONS

ARNOLD L. GROSSBERG and JOHN M. ROEBUCK*

California Research Corp., Richmond, Calif.

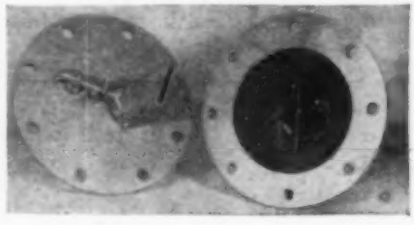
ACCURATE reflux control in the operation of pilot plant fractionation equipment is essential for satisfactory distillations and steady performance of interrelated equipment. Also, accurate knowledge of the reflux ratio is necessary if the results of distillations are to be used for design purposes.

In the case of small columns with total overhead rates in the range of 10 to 100 g.p.h., standard orifice type instruments offer disadvantages for controlling column reflux because of their expense and susceptibility to serious inaccuracies due to the small orifices. Furthermore, the use of orifice-type meters necessitates additional head on the reflux stream, thus involving liquid holdup in the system, and is therefore objectionable in batch operations.

It has been common practice in experimental columns to employ a partial condenser built into the top of the column to condense and return reflux, with a separate condenser installed for the net product. Accurate control of such an arrangement is exceedingly difficult, however, particularly at high reflux ratios where only slight variations in the column vapor traffic or in the condensing rate will cause the net product rate to fluctuate widely.

The automatic ratio controller and electrical impulse timer described herein were developed to meet the need for an accurate reflux control system suitable for pilot scale distillation equipment. This control system may be used to split automatically any small liquid stream into two accurate fractions. In applying the system to the control of distillation column reflux, the total overhead stream from the column is condensed and allowed to gravitate into the automatic ratio controller which takes a portion of the liquid as overhead product and returns the balance to the column as reflux. Provisions are made to permit separation of liquid and vapor ahead of the controller and consequently vapor binding is avoided in the liquid lines from the controller.

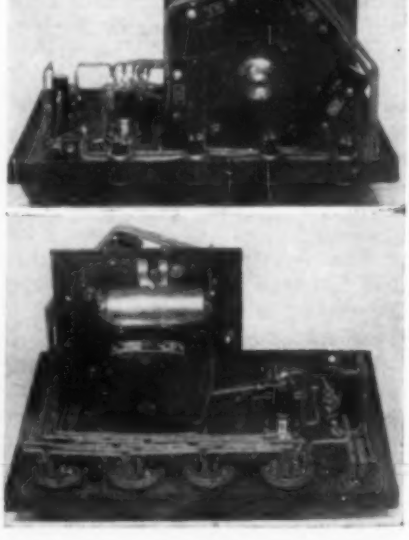
Fig. 1—Flow splitter for reflux control



Ratio Controller—The ratio controller illustrated in Fig. 1 consists of a hinged spout which directs the liquid flow to either side of a baffle dividing a

Fig. 2—Top views of timer showing switches

Fig. 3—Bottom view of timer showing motor



*Present address, Standard Oil Co. of California, San Francisco.

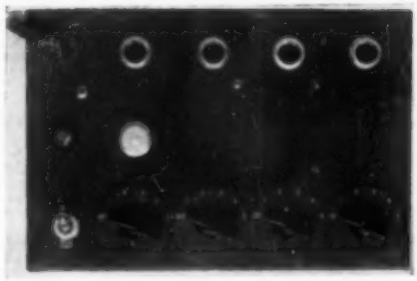


Fig. 4—Timer panel board

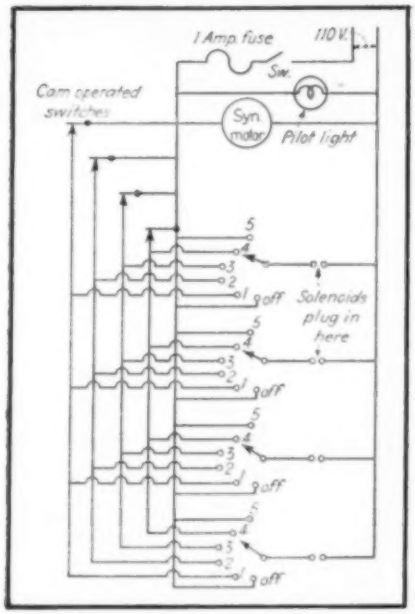


Fig. 5—Wiring diagram of timer

2 x 3-in. eccenric reducer. The spout is activated through a linkage to an iron plunger which rises and falls within a brass or stainless steel tube surrounded by the timer operated solenoid.

The unit pictured is made of steel and brass, but other more resistant materials may be used. The plunger may be made corrosion resistant by plating or enameling carbon steel, or by employing 50 percent nickel steel alloy. The ratio controller shown in Fig. 1 was designed for pressures up to 50 psi. ga. but, inasmuch as no packing glands are involved, it may readily be designed for higher pressure operation.

Results Achieved

The liquid split made by the ratio conroller is in close agreement with the impulse time regardless of flow rate, so long as the total overhead liquid flow rate is uniform. In addition, the controller has the advantage of freedom from the difficulties encountered with seating type valves.

Timer—The timer consists of a group of Micro switches and cams (Fig. 2), one switch for each ratio desired. Each switch is mounted so as to be tripped by one cam which is made to hold the switch on for any desired fraction of the time. Care must be taken to avoid withholding reflux from the column for long intervals. Accordingly, most units have been designed so that this interval is less than one second.

The cams are on a common shaft and are geared to an electric motor as in Fig. 3. Generally a four-switch unit providing reflux raios of 1:1, 2.5:1, 5:1 and 20:1 will suffice, but more switches may be included and reflux ratios as high as 100:1 may be obtained conveniently with a 1 rpm. motor. One timer may be used to operate several columns concurrently with the same or different reflux ratios. Fig. 4 presents a view of the timer panel board and a wiring diagram for the timer is shown in Fig. 5.

The authors wish to acknowledge the assistance of V. C. Davis, K. R. Eldredge and L. T. Folsom of the California Research Corp. and G. R. Skopecek, Jr., of Bechtel Bros. McCone Co. in this development.

TRUCK CRANE ELIMINATES PLANT BOTTLENECK

When one step in a process limits the output of a whole plant, at a time when new buildings and machinery are difficult to obain, the result is usually a first class management problem. Emptying the wash mills at the U. S. Glue Division of Peter Cooper at Carrolville, Wis., was such a problem. The first step in making dry hide glue is washing the untanned hide scraps from the tanneries. These are dumped in the wash mills. After washing, the water is drained and the scraps loaded into industrial cars.

Laborers with rubber boots and hand forks formerly did the unloading. This was the kind of work usually performed by newly arrived immigrants who could not speak English. With the draft and wartime upgrading, glue production was limited by the number of laborers who could be obtained for wash mill unloading.

Mechanization was imperative but with limited head room, building columns and wash mill machinery, the usual type of crane could not be installed. R. C. Ramstack, general manager for U. S. Glue, solved this problem by the purchase of an all hydraulic truck crane mounted on a jeep. Mr. Ramstack does not consider this the final answer to all production problems but the crane does meet all the criteria such as reduced operating cost, safety, amortization of investment and desirability from a personnel standpoint.

Man-Hour Saving

A few piping changes were necessary to increase the head room in a few places. A jeep operator and two helpers now unload a mill in about 1¼ hours instead of the 3 hours taken by two men with forks. Thus 3¾ man hours with the truck crane equal 6 manual man hours. With the crane, a higher type of employee can be used. At present, the crane is used about 6 hours a day. Besides unloading wash mills it is used to unload and stack bales of raw materials.

The jeep is spotted at the wash mill and the hydraulic outriggers to prevent tipping are locked in place. The telescoping boom and 360-deg. turn permit the bucket to be lowered into any part of the mill. Special operators are not needed. Any mechanically inclined employee can be trained. The bucket is completely hydraulic and can be lowered gently and closed without banging.

Jeep-mounted hydraulic crane improved handling for U. S. Glue

NOMOGRAPHIC CHART FOR VAPOR PRESSURES

IRA J. HOOKS
New York, N. Y.

VAPOR PRESSURE p of a substance can be determined at temperature T if the vapor pressure p_o at another temperature T_o is known, together with the latent heat of vaporization L_v. Another nomograph[1] has been provided to enable L_v to be found, if it is not already available.

The chart which accomplishes this determination is based on the assumptions that: The vapor pressure is relatively low[2]; the volume in the liquid state is small compared to that in the vapor state; the temperature does not vary over wide limits; the latent heat is assumed constant within these limits; the simple gas law is obeyed; the integrated Clausius-Clapeyron equation is valid[3]. Then:

$$\log \frac{p}{p_o} = \frac{L_v}{(2.303)\,(1.99)}\,(1/T_o - 1/T)$$

The use of the nomograph is illustrated for ethyl ether: Here p_o is 185 mm. Hg; L_v is 6,850 cal. per gram mol; T_o is 273 deg. K.; and T is 293 deg. K. To eliminate calculation of the reciprocals of two temperatures involved, the accompanying table gives the reciprocals for T_o and T from 200 to 600. For the problem in hand $1/T_o - 1/T = 3{,}663 - 3{,}413 = 250$. Then following the key on the nomograph connect 250 with 6,850 on the L_v scale, transfer the R_1 value to the R_2 scale and connect $p_o = 185$ through R_1 to the result, $p = 437$ mm. Hg. The experimental value is 442.

References

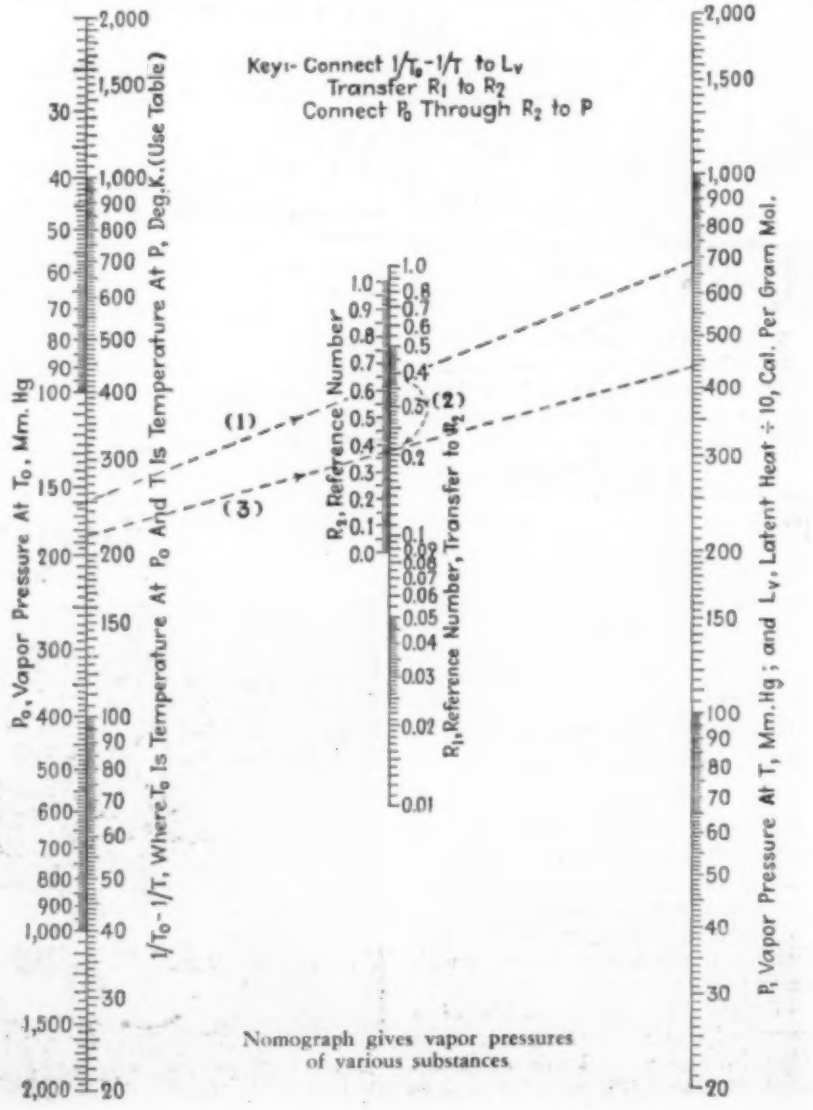
1. *Chem. & Met.*, April 1946, p. 117.
2. *Chem. & Met.*, June 1946, p. 117.
3. Hougen & Watson, "Industrial Chemical Calculations," 2nd ed., John Wiley & Sons, Inc., New York.

Value of Reciprocal of T

T	1/T	T	1/T	T	1/T	T	1/T	T	1/T
200	5,000	300	3,333	400	2,500	500	2,000		
01	4,975	01	3,322	01	2,494	01	1,996		
02	4,950	02	3,311	02	2,488	02	1,992		
03	4,926	03	3,300	03	2,481	03	1,988		
04	4,902	04	3,289	04	2,475	04	1,984		
205	4,878	305	3,279	405	2,469	505	1,980		
06	4,854	06	3,268	06	2,463	06	1,976		
07	4,831	07	3,257	07	2,457	07	1,972		
08	4,808	08	3,247	08	2,451	08	1,969		
09	4,785	09	3,236	09	2,445	09	1,965		
210	4,762	310	3,226	410	2,439	510	1,961		
11	4,739	11	3,215	11	2,433	11	1,957		
12	4,717	12	3,205	12	2,427	12	1,953		
13	4,695	13	3,195	13	2,421	13	1,949		
14	4,673	14	3,185	14	2,415	14	1,946		
215	4,651	315	3,175	415	2,410	515	1,942		
16	4,630	16	3,165	16	2,404	16	1,938		
17	4,608	17	3,155	17	2,398	17	1,934		
18	4,587	18	3,145	18	2,392	18	1,931		
19	4,566	19	3,135	19	2,387	19	1,927		
220	4,545	320	3,125	420	2,381	520	1,923		
21	4,525	21	3,115	21	2,375	21	1,919		
22	4,505	22	3,106	22	2,370	22	1,916		
23	4,484	23	3,096	23	2,364	23	1,912		
24	4,464	24	3,086	24	2,358	24	1,908		
225	4,444	325	3,077	425	2,353	525	1,905		
26	4,425	26	3,067	26	2,347	26	1,901		
27	4,405	27	3,058	27	2,342	27	1,898		
28	4,386	28	3,049	28	2,336	28	1,894		
29	4,367	29	3,040	29	2,331	29	1,890		

Values of 1/T (Cont.)

T	1/T	T	1/T	T	1/T	T	1/T	T	1/T	T	1/T	T	1/T	T	1/T
230	4,348	330	3,030	430	2,326	530	1,887	265	3,774	365	2,740	465	2,151	565	1,770
31	4,329	31	3,021	31	2,320	31	1,883	66	3,759	66	2,732	66	2,146	66	1,767
32	4,310	32	3,012	32	2,315	32	1,880	67	3,745	67	2,725	67	2,141	67	1,764
33	4,292	33	3,003	33	2,309	33	1,876	68	3,731	68	2,717	68	2,137	68	1,761
34	4,274	34	2,994	34	2,304	34	1,873	69	3,717	69	2,710	69	2,132	69	1,757
235	4,255	335	2,985	435	2,299	535	1,869	270	3,704	370	2,703	470	2,128	570	1,754
36	4,237	36	2,976	36	2,294	36	1,866	71	3,690	71	2,695	71	2,123	71	1,751
37	4,219	37	2,967	37	2,288	37	1,862	72	3,676	72	2,688	72	2,119	72	1,748
38	4,202	38	2,959	38	2,283	38	1,859	73	3,663	73	2,681	73	2,114	73	1,745
39	4,184	39	2,950	39	2,278	39	1,855	74	3,650	74	2,674	74	2,110	74	1,742
240	4,167	340	2,941	440	2,273	540	1,852	275	3,636	375	2,667	475	2,105	575	1,739
41	4,149	41	2,933	41	2,268	41	1,848	76	3,623	76	2,660	76	2,101	76	1,736
42	4,132	42	2,924	42	2,262	42	1,845	77	3,610	77	2,653	77	2,096	77	1,733
43	4,115	43	2,915	43	2,257	43	1,842	78	3,597	78	2,646	78	2,092	78	1,730
44	4,098	44	2,907	44	2,252	44	1,838	79	3,584	79	2,639	79	2,088	79	1,727
245	4,082	345	2,899	445	2,247	545	1,835	280	3,571	380	2,632	480	2,083	580	1,724
46	4,065	46	2,890	46	2,242	46	1,832	81	3,559	81	2,625	81	2,079	81	1,721
47	4,049	47	2,882	47	2,237	47	1,828	82	3,546	82	2,618	82	2,075	82	1,718
48	4,032	48	2,874	48	2,232	48	1,825	83	3,534	83	2,611	83	2,070	83	1,715
49	4,016	49	2,865	49	2,227	49	1,821	84	3,521	84	2,604	84	2,066	84	1,712
250	4,000	350	2,857	450	2,222	550	1,818	285	3,509	385	2,597	485	2,062	585	1,709
51	3,984	51	2,849	51	2,217	51	1,815	86	3,497	86	2,591	86	2,058	86	1,706
52	3,968	52	2,841	52	2,212	52	1,812	87	3,484	87	2,584	87	2,053	87	1,704
53	3,953	53	2,833	53	2,208	53	1,808	88	3,472	88	2,577	88	2,049	88	1,701
54	3,937	54	2,825	54	2,203	54	1,805	89	3,460	89	2,571	89	2,045	89	1,698
255	3,922	355	2,817	455	2,198	555	1,802	290	3,448	390	2,564	490	2,041	590	1,695
56	3,906	56	2,809	56	2,193	56	1,799	91	3,436	91	2,558	91	2,037	91	1,692
57	3,891	57	2,801	57	2,188	57	1,795	92	3,425	92	2,551	92	2,033	92	1,689
58	3,876	58	2,793	58	2,183	58	1,792	93	3,413	93	2,545	93	2,028	93	1,686
59	3,861	59	2,786	59	2,179	59	1,789	94	3,401	94	2,538	94	2,024	94	1,684
260	3,846	360	2,778	460	2,174	560	1,786	295	3,390	395	2,532	495	2,020	595	1,681
61	3,831	61	2,770	61	2,169	61	1,783	96	3,378	96	2,525	96	2,016	96	1,678
62	3,817	62	2,762	62	2,165	62	1,779	97	3,367	97	2,519	97	2,012	97	1,675
63	3,802	63	2,755	63	2,160	63	1,776	98	3,356	98	2,513	98	2,008	98	1,672
64	3,788	64	2,747	64	2,155	64	1,773	99	3,344	99	2,506	99	2,004	99	1,669


Key:- Connect 1/T₀-1/T to Lv
Transfer R1 to R2
Connect P₀ Through R2 to P
P₀, Vapor Pressure At T₀, Mm. Hg
1/T₀-1/T, Where T₀ Is Temperature At P₀ And T Is Temperature At P, Deg.K. (Use Table)
R₂, Reference Number
R₁, Reference Number, Transfer to R₂
P, Vapor Pressure At T, Mm.Hg; and Lv, Latent Heat ÷ 10, Cal. Per Gram Mol.
(1)
(2)
(3)
Nomograph gives vapor pressures of various substances

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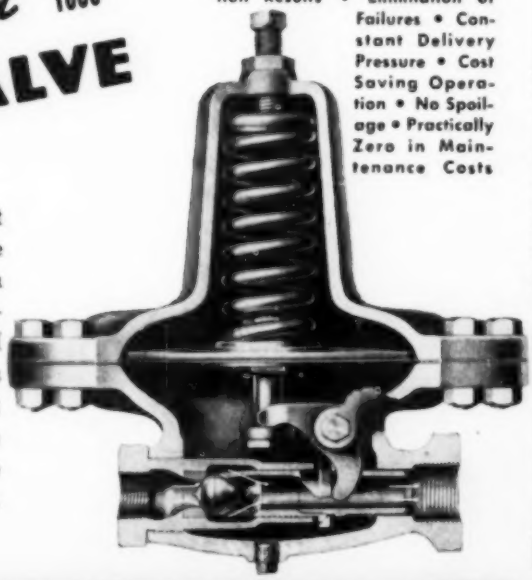

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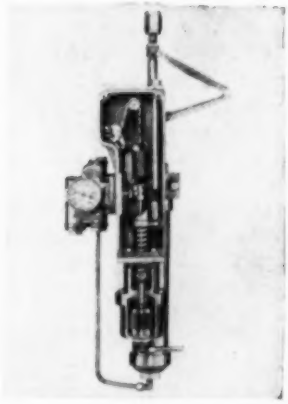

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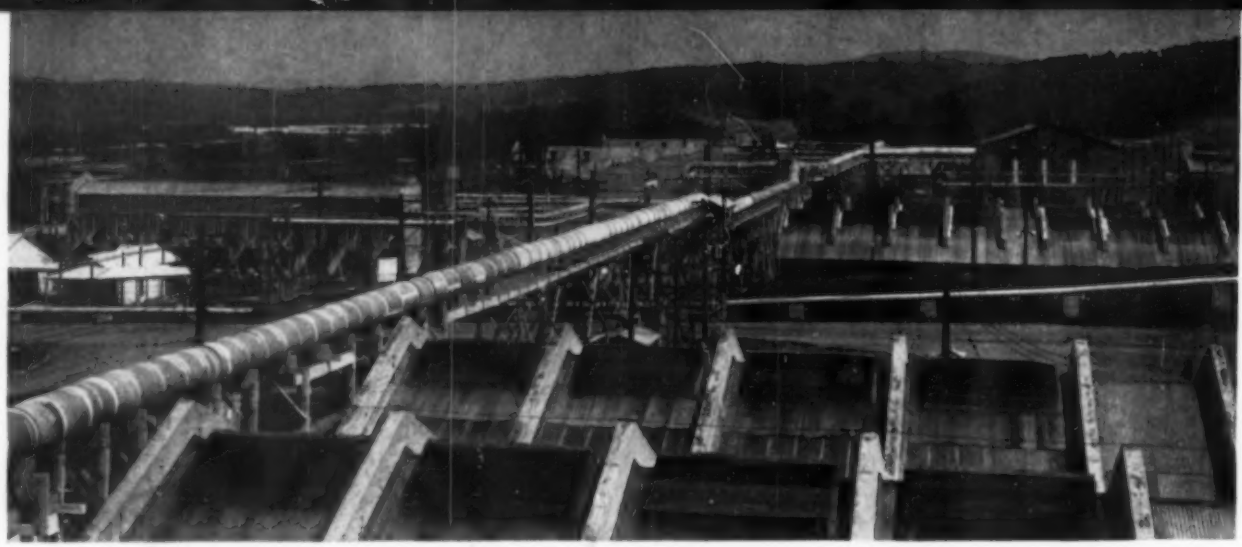

1 Duct system in smokeless powder plant collects solvent evaporated during mixing, maceration, and extrusion of powder. Vapor-laden air is delivered to activated carbon recovery plant

SOLVENT RECOVERY
With Activated Carbon

THE SOLVENT recovery scheme depicted here is a "Columbia" activated carbon system, as adapted for use in smokeless powder plants. It, and the special extruded carbon used in it, were developed by Carbide and Carbon Chemicals Corp. during the past two decades (see article p. 98).

During the war, twenty-three of these recovery plants were installed in the government's ten smokeless powder plants to recover alcohol and ether. Except in the number of adsorbers, which varied from three to eight, the six adsorber unit shown here is a typical powder plant installation. All were completely automatic in their operation and control.

In the processing of smokeless powder, large quantities of solvent vaporize during the mixing, macerating, extrusion, and cutting operations. These vapors are collected and the vapor-laden air is drawn through large ducts by blowers which discharge to the activated carbon recovery plant. Vapor collection systems are provided by the powder manufacturer with filters, auxiliary blowers, emergency vents, and all other necessary safety devices.

After the vapor-laden air has passed through the tempering chamber it is delivered to a number of adsorbers where it passes downward through the bed of activated carbon. Alcohol and ether vapors are adsorbed and held, while the denuded air is discharged to the atmosphere. When the carbon has adsorbed the optimum quantity of solvent the vapor-laden air is diverted to other adsorbers, and low pressure steam is passed upward at a controlled rate through the beds of charged carbon to drive out the adsorbed solvent. As soon as the steaming is complete the adsorber is ready to receive vapor-laden air once more.

By properly staggering the sequence of operations among the several adsorbers it is possible to process the incoming vapor-laden air without interruption. Although details differ from plant to plant, one satisfactory arrangement for a six-adsorber plant would be to have two adsorbers steaming and four adsorbing.

After the steam-solvent mixture from the adsorbers has been condensed, it passes to a continuous decanter, where the water-insoluble ether layer is separated from the water layer. Alcohol and ether are recovered by distillation in equipment supplied by the powder manufacturer. Some plants purified the decanted ether layer by distillation, while others used it directly.

CHEMICAL ENGINEERING

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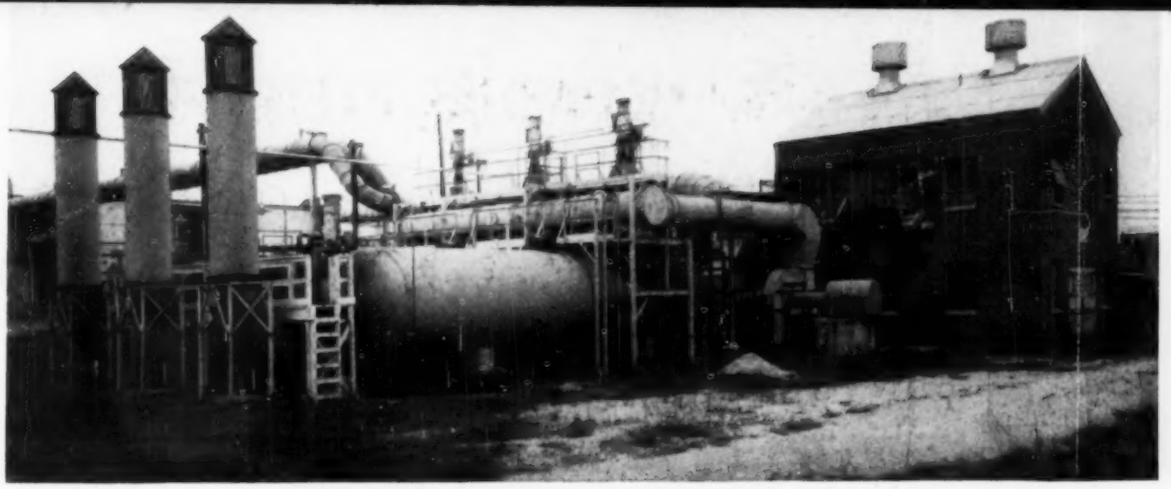
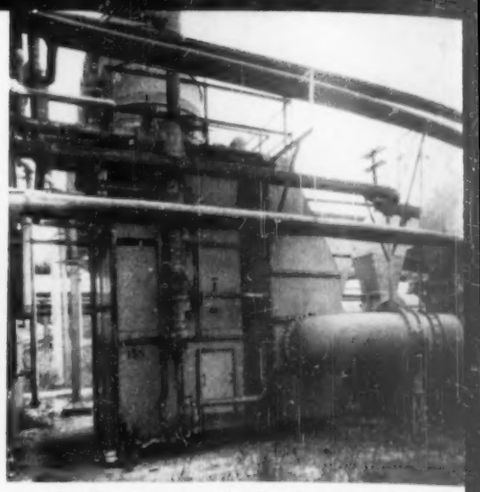
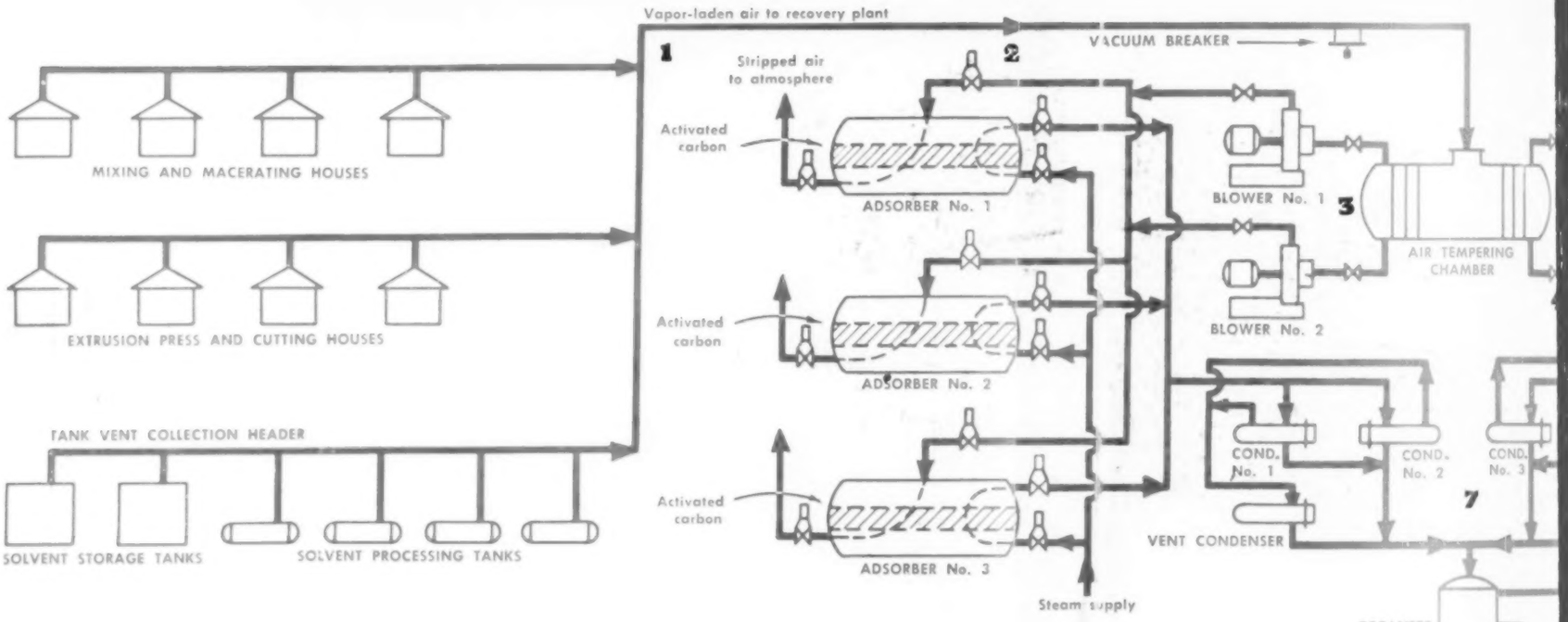


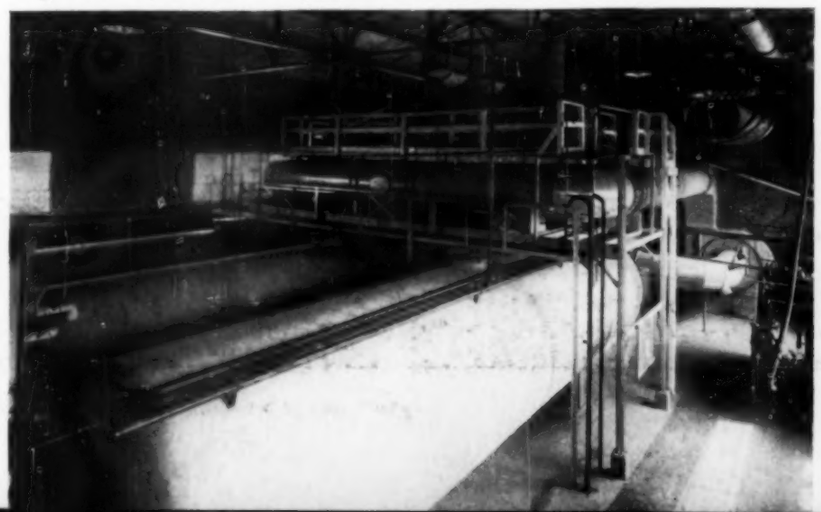
2 Many powder plant installations like this three-adsorber unit were mostly uninclosed. Small building houses control panel, condensers, starters, and intermediate storage tanks



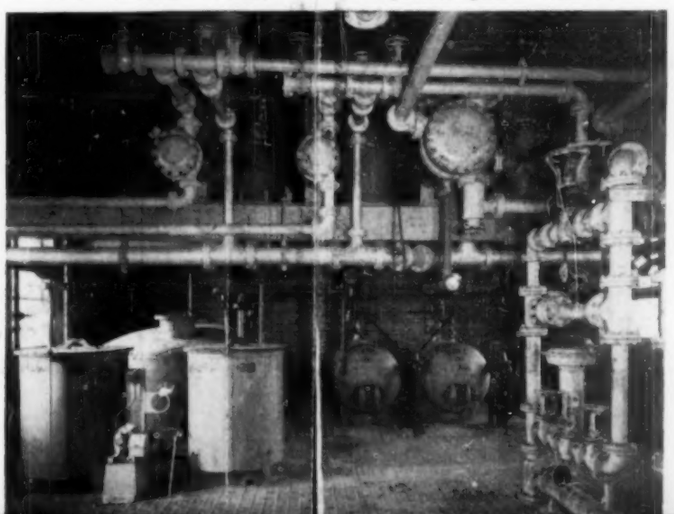
3 Air tempering chamber in powder-plant recov air enters top of chamber and is drawn out near b

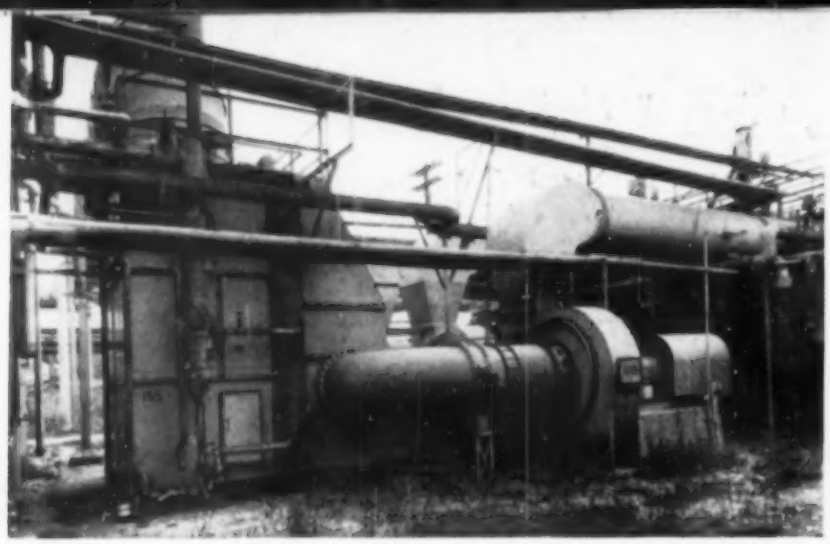


6 Typical powder plant installation. Automatically controlled, cylinder operated gate valves cycle steam and vapor-laden air through the three adsorbers

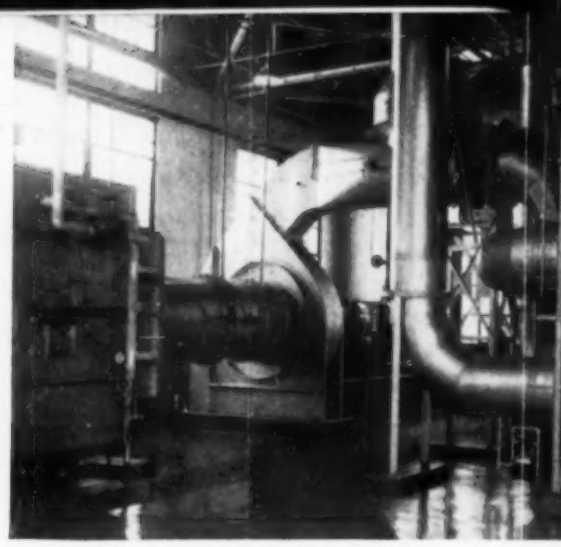


7 Continuous decanter (behind two water treating tanks) and ends of three condensers. Part of powder plant installation

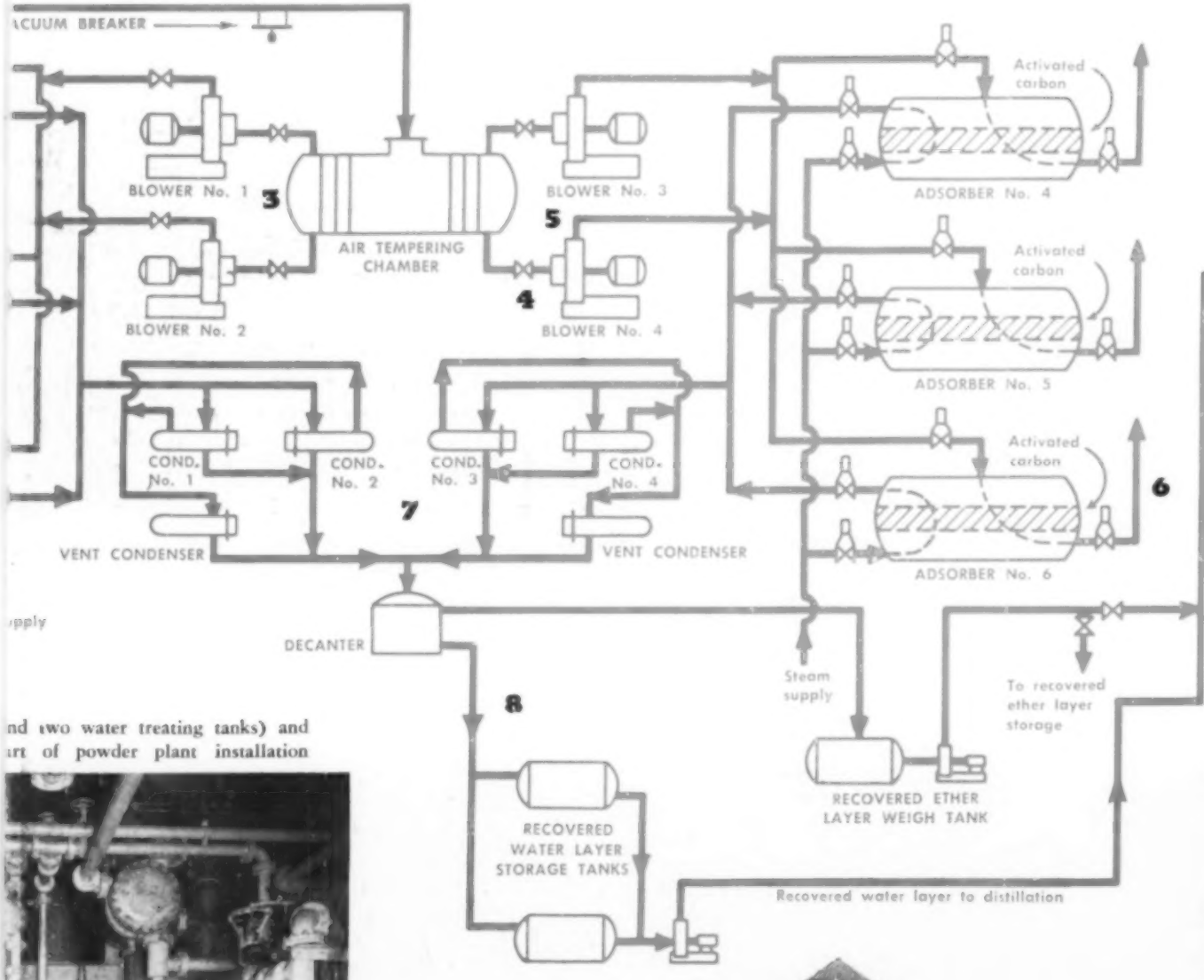




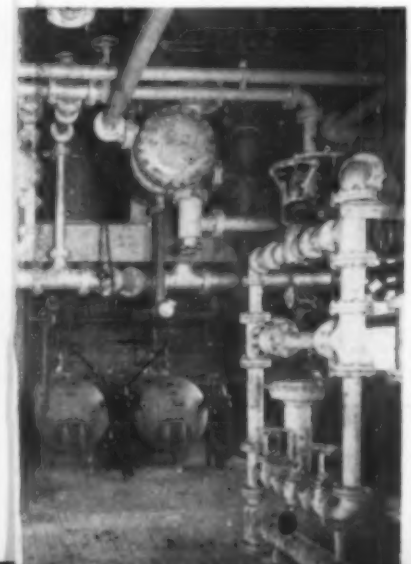
3 Air tempering chamber in powder-plant recovery system. Vapor-laden air enters top of chamber and is drawn out near bottom by three blowers



4 View in powder plant showing tempering chamb adsorber (with vapor-laden air header near top, ex



nd two water treating tanks) and
art of powder plant installation



8
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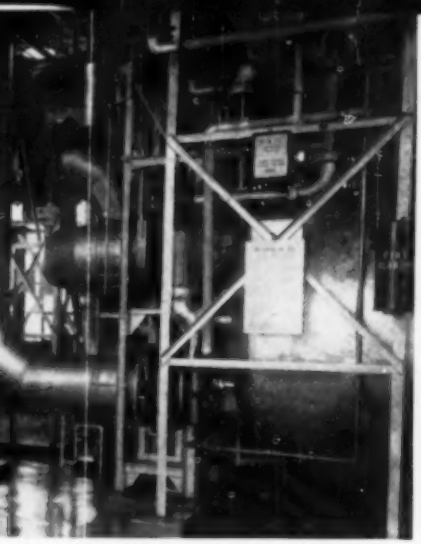
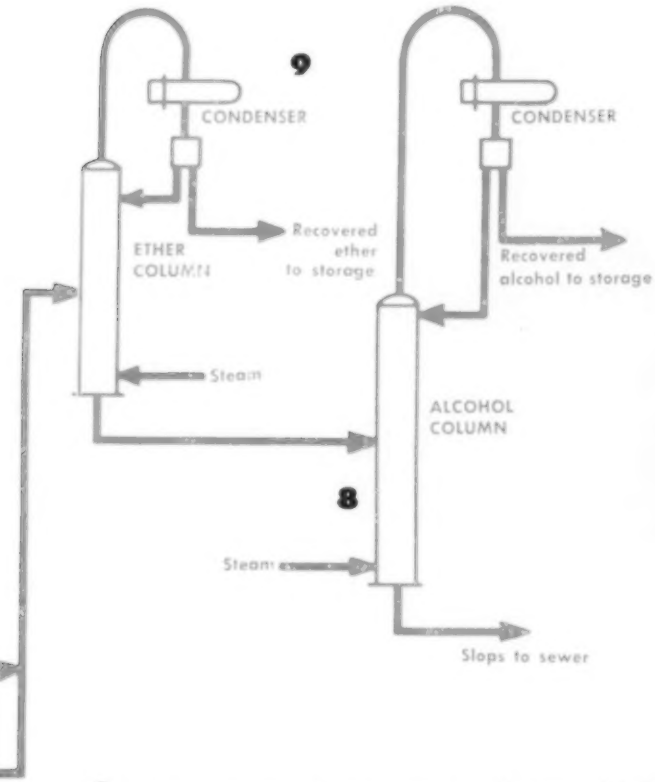
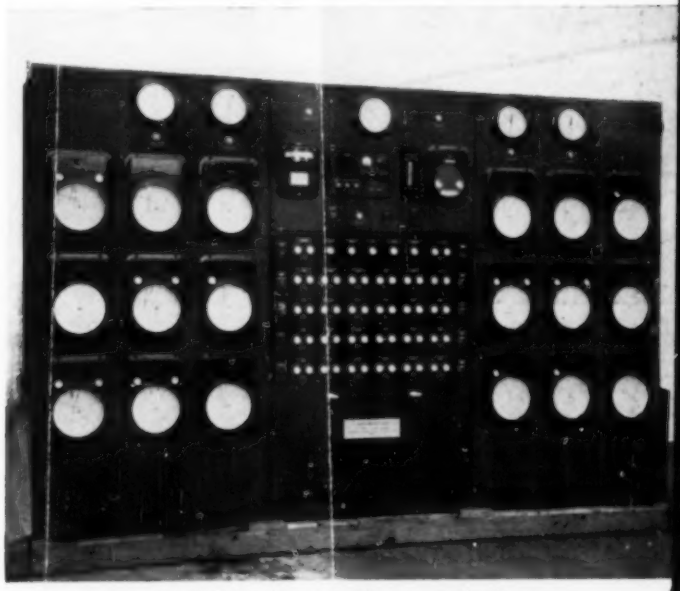
PICTURED "Chem & Met" FLOWSHEET



bering chamber, blower, and end of one near top, exhaust duct near bottom)

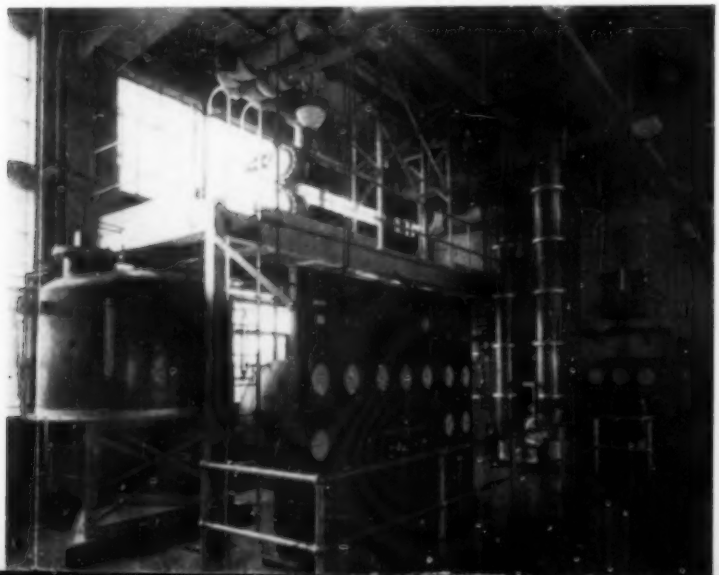
5 Blower used in solvent recovery system in a printing plant. Like those in powder plant systems, it is equipped for automatic air volume control



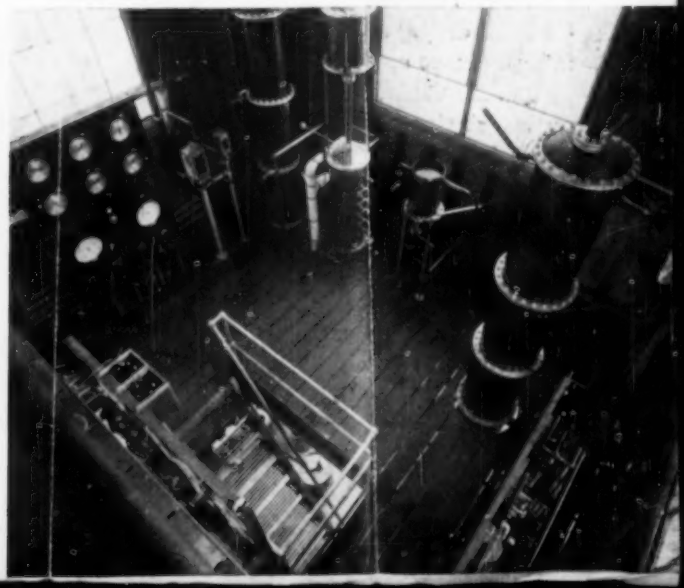


Instrument panel for a four-adsorber, completely automatic industrial solvent recovery installation

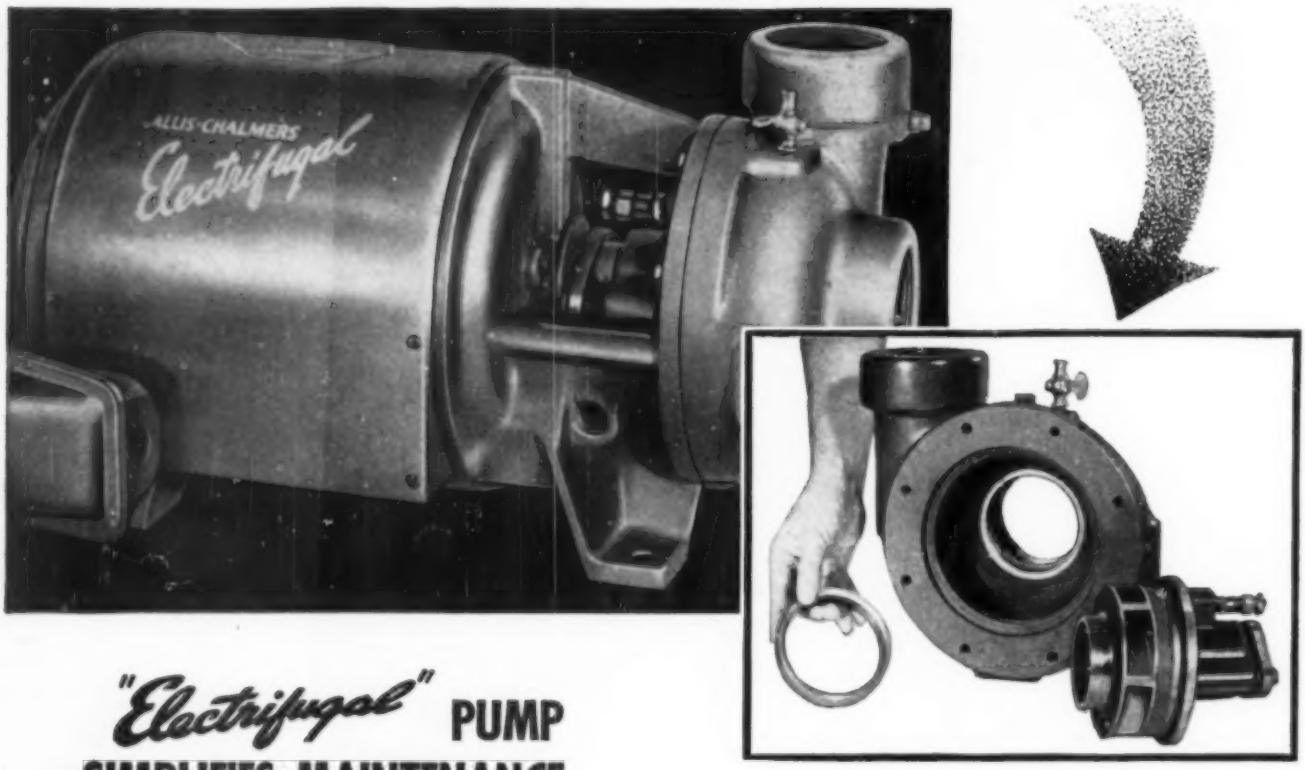
8 In this commercial unit, note the decanter, distillation columns, and two condensers above the instrument panel



9 Distillation equipment in commercial plant. Water-insoluble solvents often require no distillation



ALL PUMP AND MOTOR PARTS ARE
Quickly Accessible



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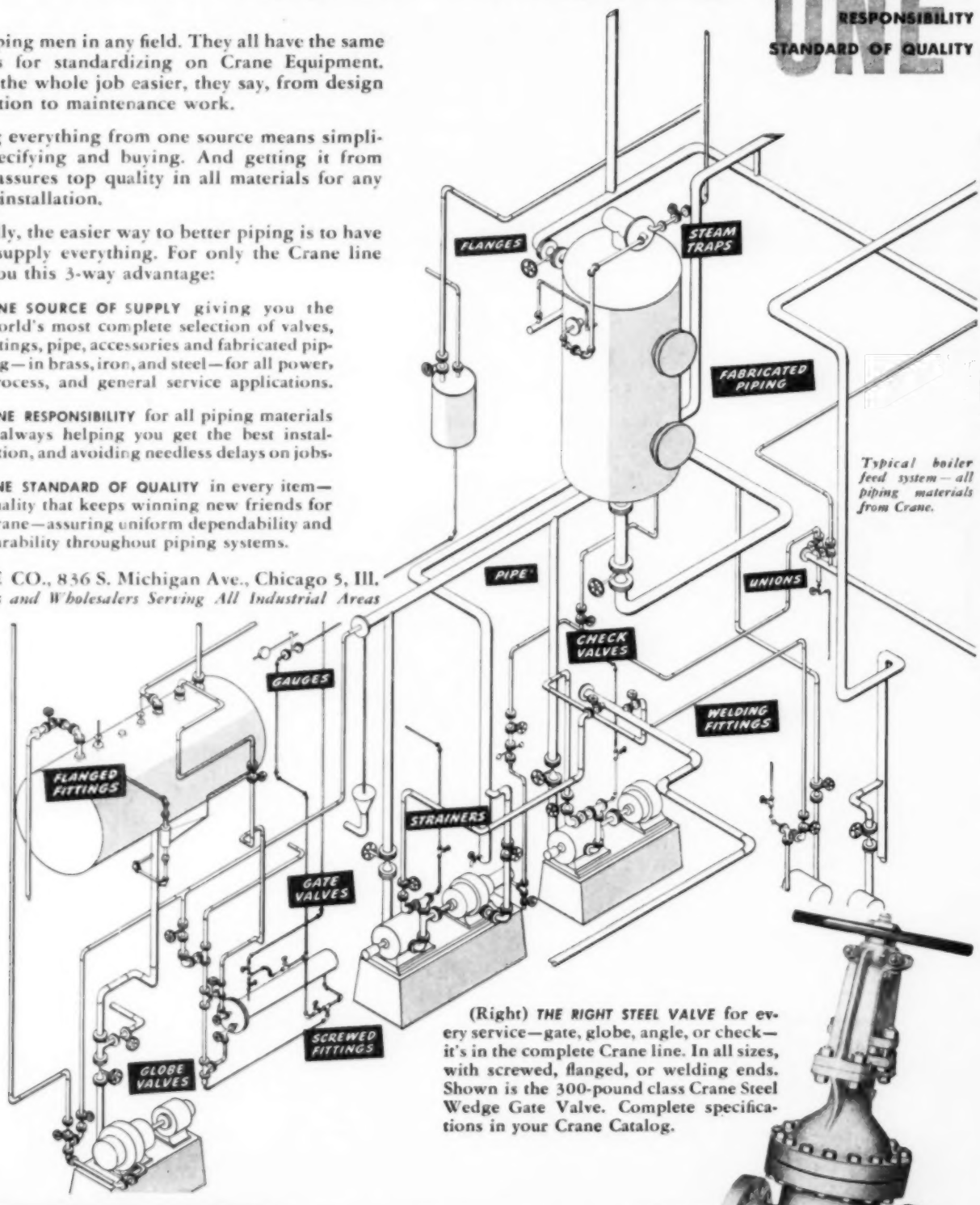
ONE STANDARD OF QUALITY in every item—quality that keeps winning new friends for Crane—assuring uniform dependability and durability throughout piping systems.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



Typical boiler feed system—all piping materials from Crane.

(Right) *THE RIGHT STEEL VALVE* for every service—gate, globe, angle, or check—it's in the complete Crane line. In all sizes, with screwed, flanged, or welding ends. Shown is the 300-pound class Crane Steel Wedge Gate Valve. Complete specifications in your Crane Catalog.

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FOR EVERY PIPING SYSTEM

SINCE 1887
60 YEARS' EXPERIENCE
1887 Air Separation
1888 Automatic Pulverizers
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1922 Imp Pulverizers
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TO HELP SOLVE YOUR PULVERIZING PROBLEMS
THREE SCORE YEARS of "doing things" have taught us the "know-how" in solving pulverizing and separating problems.
We can offer you a complete line of grinding mills in different sizes: from small Laboratory Units up to Super Roller Mills delivering capacities of forty tons per hour or more . . . in a fineness range from granular through the intermediate grades up to 400-mesh materials with particle sizes 95% to 99% finer than 5 to 10 microns.
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PROCESS EQUIPMENT NEWS

Theodore R. Olive, ASSOCIATE EDITOR

THICKNESS DETECTOR

THICKNESSES of a variety of materials, including metals such as steel, aluminum, brass and copper, and nonmetals such as glass, can be determined from one side only, by means of a new acoustic thickness gage, the Audigage, Model FMSS-4, announced by Branson Instruments, Inc., Joe's Hill Road, Danbury, Conn. This light-weight, portable, self-contained instrument includes its own power supply and can be used in measuring the thickness of pipes, storage tanks, pressure vessels and other equipment in the range from ¼ to 12 in. It is claimed that factors such as the kind of material, condition of the reflecting surface, backing-up liquids, process scale, etc., vary the audible indications and provide the instrument user with useful information, but that they do not influence the accuracy of the thickness measurement.

The device utilizes a crystal-type gage head, powered by a frequency-modulated electronic oscillator. When the vibrating crystal is applied to a wall surface, mechanical resonance of the wall thickness can be produced directly below the crystal. The fundamental frequency at which the wall section will resonate is directly proportional to the velocity of sound in the material and inversely proportional to the thickness. The instrument provides a means whereby audible signals are produced corresponding to harmonic resonance in the material. Such signals are picked up by the operator in a pair of light-weight earphones. The frequency difference between any two adjacent audible signals can be read on the tuning dial and converted directly into wall thickness on a concentric thickness scale. If the velocity of sound in the material is already known, the device can be used directly, otherwise it can readily be determined by measuring the frequency produced in a sample of known thickness.

Acoustic thickness detector

Portable detector for leaks

The instrument is simple to use. The small crystal can be applied to flat surfaces as well as to curved surfaces with a radius of 1 in. or more. It is desirable to apply a thin film of oil or grease between the crystal and the work to provide good supersonic coupling. Frequently no further surface preparation is required as the supersonic wave is said to be transmitted through mill scale, plating, enamels, and even thin coats of hard paint. However, if the surface is extremely rough or covered with a thick paint layer, a few strokes of a file will give a suitable surface, it is claimed. Porous material, such as cast iron and concrete, can not be measured in this fashion.

VACUUM LEAK INDICATOR

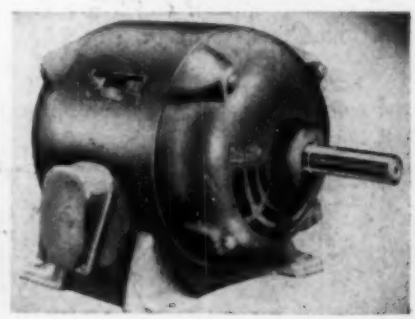
AUDIBLE warnings of the presence of minute leaks in pressure or vacuum systems can be secured quickly and easily, according to the Consolidated Engineering Corp., Pasadena 4, Calif., with a new portable leak detecting instrument that has just been announced. This detector is a simplified mass spectrometer, tuned to helium gas, which separates any helium present in the spectrometer tube from other gases that may be mixed with it and gives an immediate visual signal on a meter, or an audible signal the pitch of which gives a rough approximation of the size of the leak. Helium is used as a probe gas in searching for leaks, both because of its extremely small natural concentration in the atmosphere and because it diffuses rapidly owing to low molecular weight, and hence gives rapid results. Leaks as small as 10^{-8} c.c. per second can be detected in this way, it is claimed.

Since only a few connections between instrument and tested equipment are needed, and only a few adjustments must be made in use, inexperienced people can quickly learn to operate the detector. Six sensitivity ranges are available for measuring almost any leakage rate. The instrument is portable, being contained in a cabinet 43 in. high and 25 by 22 in. in cross section, mounted on ball bearing casters. Standard tubes are used, access can easily be gained to the wiring, and operation is on standard 115-volt, 60-cycle current.

ALL-STEEL MOTOR

A SAVING of 35 percent in size without sacrifice of electrical properties is claimed for a new line of all-steel, squirrel-cage induction motors manufactured under the name of "Life-Line" by Westinghouse Electric Corp., Pittsburgh, Pa. These motors, produced in sizes from ½ to 20 hp., are available in a wide range of speeds and voltages, in two- and three-phase

All-steel induction motor



types, for 60-, 50- and 25-cycle current. They are produced in open, drip-proof, splash-proof and fan-cooled constructions, employing a frame rolled from steel plate, feet and end brackets of heavy pressed steel, all-welded construction, self-sealed, prelubricated ball bearings, and special synthetic resin-covered wire for coils. It is claimed that the ball bearings will operate for five years or longer without repacking.

PIRANI GAGE

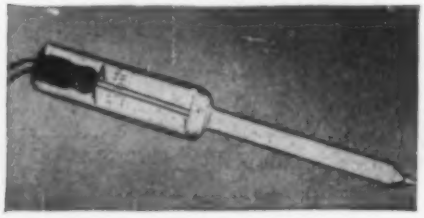
PRESSURE readings with an accuracy of plus or minus 5 percent, in the pressure range from 1 to 1,000 microns, may be made with the new line of Pirani tubes available from the Electronics Division of Sylvania Electric Products, Inc., 500 Fifth Ave., New York 18, N. Y. These tubes employ a special tungsten filament having a high temperature coefficient of resistance. Change in gas pressure surrounding the filament produces a change in thermal conductivity and hence of filament temperature and filament resistance. Measurement of the filament resistance then indicates gas pressure on a milliammeter in a simple bridge circuit.

For greatest accuracy the company recommends the use of matched pairs of Pirani tubes, one being sealed directly into the evacuating system, while the second compensating tube is left intact, opened to the surrounding air, or filled with a specific gas to a standard pressure. The tubes, which operate at 1.5 volts and 100 milliamperes, have a cold filament resistance of 6.6 ohms and a hot resistance at 100 milliamperes in evacuated tube ranges from 15.5 to 17 ohms.

GANTRY CRANE

A NEW portable standard industrial crane, with a capacity of 1 ton, for use on loading platforms and for construction and maintenance work, has been announced by Industrial Equipment Co., 315 North Ada St., Chicago 7, Ill. The crane, which is readily dismantled for storage or shipment, consists of a pair of structural steel legs carried on casters, fastened at their top to a bridge beam of I cross-section on which a trolley and chain hoist can be suspended. Neither trolley nor chain hoist are provided, but, employing customary sizes, the usual height from hoist hook to floor is approximately 7 ft., while the span between the gantry legs is 10 ft. 8 in. at the bottom. The construction is clearly indicated in the accompanying illustration.

Pirani tube for vacuum measurements



1-Ton industrial gantry crane

HYDRAULIC DRIVE MOTOR

WHAT IS known as the Electrofluid Drive is a new "packaged" power unit consisting of a motor and hydraulic drive that is now being offered by Link-Belt Co., 307 North Michigan Ave., Chicago 1, Ill. Available in sizes up to 20 hp., the drive serves as an automatic clutch, enabling high inertia loads to be started by ordinary motors without excessive high starting current peaks. As the accompanying illustration shows, the hydraulic coupling is attached directly to one end bell of the motor, the coupling proper consisting of a primary and a secondary element. The primary element may be likened to a centrifugal pump impeller, and the secondary to a waterwheel or runner. The coupling is filled with a light mineral oil. When the motor drives the impeller it causes oil to flow through the runner buckets back to the impeller, thereby rotating the runner. Thus, motor torque is transmitted from the impeller to runner without mechanical connection, through the medium of the oil which acts as a cushion between prime mover and the driven machine.

In use the motor accelerates quickly, developing torque in the fluid coupling in the ratio of the square of the speed, until sufficient torque (up to the maximum running torque of the motor) is developed to start the driven load. Should the driven machine become stalled, the drive will pull to the maximum torque capacity of the motor, thereby drawing sufficient current to cause the thermal overload protective device to function within a few seconds. However, in the meantime, the coupling absorbs the energy, protecting the driven machine from the shock of the rotor's inertia under sudden stoppage. Furthermore, the drive will deliver maximum motor torque to overcome a momentary demand which might otherwise shear a pin or stop the power source completely, this cushioning effect protecting both motor and driven equipment. Finally, shock loads from the driven side are smoothed out and cannot reach the motor.

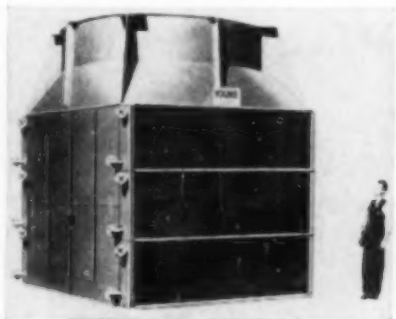
The new drive is said to be particularly suitable for high-inertia loads such as heavy fly-wheel machinery, conveyors, compressors, paper mill machinery, ball mills, rubber mills, etc.

WATER COOLING UNIT

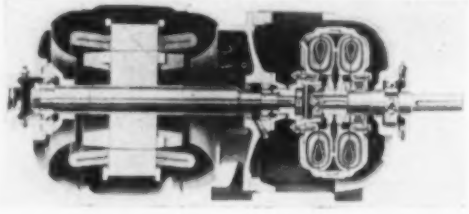
WATER COOLING units in capacities ranging upward from 3,600,000 B.t.u. per hr. at standard conditions are available in the new VAD line of fan-operated water coolers announced by Young Radiator Co., Racine, Wis. These units, which are also suitable for oil cooling, steam and vapor condensing, and gas cooling, as well as combination arrangements to handle two or more types of service, consist of a plenum chamber on two opposite sides of which are the extended-surface water cooling coils, and above which is the induced draft fan discharging vertically upward through a short stack.

Since the cooling faces are located on opposite sides of the unit, line installation of several units can be employed where very large capacities are required, without loss of efficiency

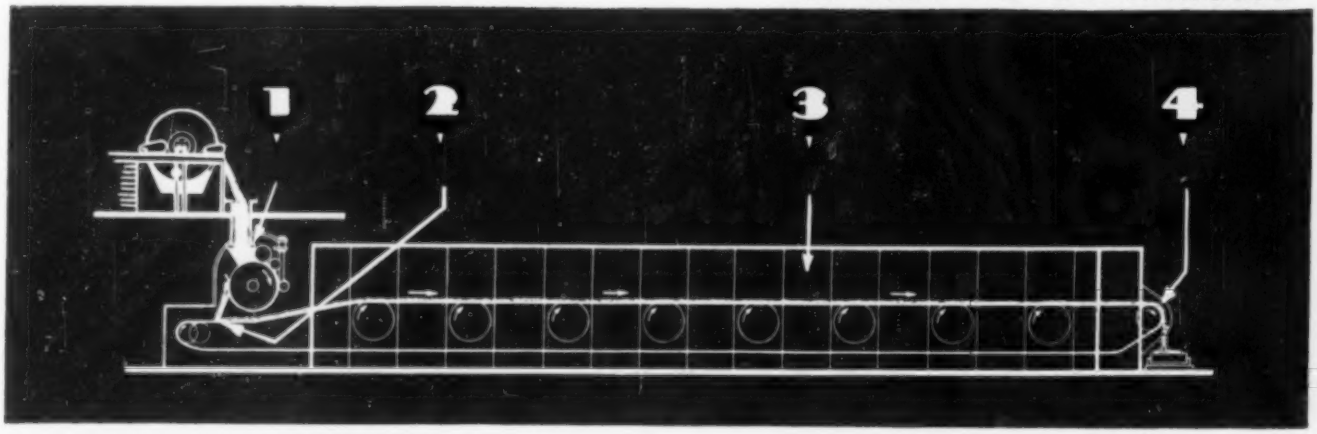
Induced draft water cooler



Motor with hydraulic drive



Magnesium carbonate dried from moisture content of 565%* (B.D.W.B.) to 1.0% in 29 minutes



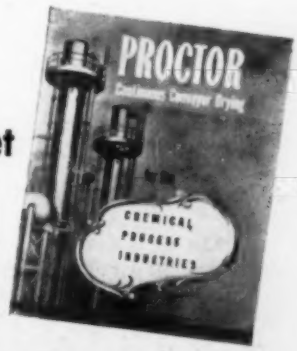
This means 5.65 lbs of water per 1.0 lb dry material

in PROCTOR CONTINUOUS CONVEYOR SYSTEM

In one typical installation of a Proctor individually designed continuous conveyor system, for use in drying magnesium carbonate, here is what takes place: (1) Material with moisture content of 565% (B.D.W.B.*) is delivered to pre-forming feed of dryer, from a continuous filter (2) Coming to the hopper of the fin drum feed in this highly moist state, the material is pressed into the grooved surface of an internally heated, revolving fin drum. On this drum, the material is dried sufficiently to be discharged to the conveyor of the continuous dryer, in the form of small sticks of uniform thickness. (3) Loaded to uniform depth on the moving conveyor, the material is conveyed through the drying chambers where heated air at 290°F. is circulated *through* the bed of magnesium carbonate. By forming the material into small, uniform shapes, more rapid diffusion is possible, which accounts for rapid drying and uniformity (4) After only 29 minutes of drying time, magnesium carbonate, uniformly dried to a moisture content of 1.0% (B.D.W.B.), is discharged from the dryer at the rate of 500 pounds (C.D.W.†) per hour

This particular application for one type of Proctor pre-forming feed, combined with a continuous conveyor dryer, illustrates just one installation. These systems are literally tailor-made to meet individual plant and product requirements . after careful research and study into the specific problem. If the drying of wet-solids is part of your operation, it will pay you to have Proctor engineers consider your problem. Write today.

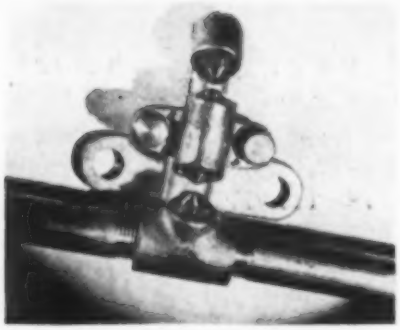
†Commercial dry weight.



This is a case history taken from this new Proctor booklet

A new 12-page booklet on "Proctor Continuous Drying for the Chemical Process Industries" is available upon request. It contains many case studies showing the application for Proctor individually designed systems. Write for your copy of this informative booklet today.

PROCTOR & SCHWARTZ, INC. Philadelphia 20, Pa.



Carbon dioxide screening nozzle

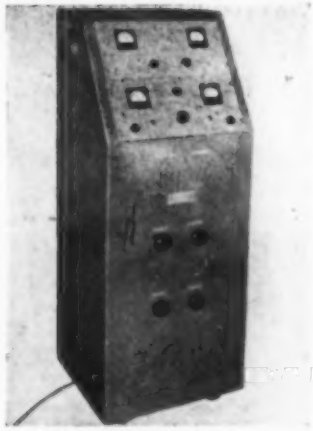
by blanking off the cooling faces. The design is said to give even air distribution and eliminate recirculation and cross-wind effects. A low fan speed is employed for high efficiency operation with minimum power consumption. Vertical mounting of the coils is said to insure easy maintenance and maximum protection from the elements. The end plates on the water coils are removable for quick and easy access to the tube headers. The fan and drive assembly are mounted independent of the main unit assembly, thereby eliminating transmission of any vibrations from moving to non-moving parts.

SCREENING NOZZLE

FOR CERTAIN sorts of fire protection systems it is desirable to be able to screen the openings into hazardous areas by means of a blanket of carbon dioxide gas, to assist in preventing indrafts from sucking air to the blaze. For such applications, which include dip tanks, fan openings and certain kinds of hooded equipment, Walter Kidde & Co., Belleville, N. J., has developed a compact screening nozzle which is usually employed in conjunction with a built-in carbon dioxide extinguishing system and is arranged to throw a curtain of carbon dioxide gas across the opening. The nozzle produces a double screen, one blast of gas shooting straight across the opening, while a second series of jets aims at an inward angle to dilute air which gets past the first screen. Such nozzles are said not only to screen a fire's oxygen supply, but also to tend to stop fire from spreading to nearby areas in the plant.

LEAK DETECTOR

AN ADAPTATION of the mass spectrometer, known as the leak detector, is being manufactured by Vacuum Electronic Engineering Co., 316 37th St., Brooklyn 32, N. Y. Offered under the trade name of Veeco, the instrument is compact and portable and is adjusted to analyze a gas for the presence of helium. This method, generally believed to offer the greatest sensitivity of any industrial leak detecting method, involves passing a continuous sample to the leak detector which is connected into the line through which the equipment under test is continuously evacuated. To detect leaks a small stream of helium is played over points of suspected leakage. Since helium is unlikely to be present in the air in significant amounts, an indication of helium by the detector during probing is conclusive proof of the presence of a leak.



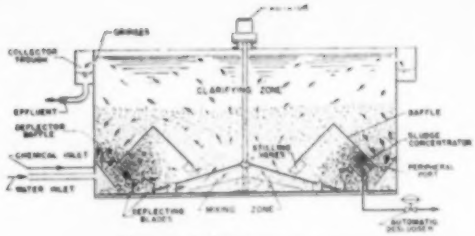
Mass spectrometer leak detector

The gas sample is ionized in the mass spectrometer which then sorts the ions by combined electric and magnetic fields, concentrating helium ions if present on the collecting target. Therefore any meter deflection indicates a leak. Sensitivity is such that the meter responds to less than one part of helium in 100,000 parts of air, corresponding to a leakage of less than 0.001 cc. (standard conditions) per hour. A feature of this extreme sensitivity is the ability of the instrument to detect the presence of small leaks, even though large leaks exist in the same equipment.

The instrument, manufactured under license from the University of Minnesota, is readily operated by non-technical personnel, taking power from a standard lighting circuit. The construction is entirely of metal, and the diffusion pump is cooled by means of a fan, requiring no cooling water.

WATER CLARIFIER

WATER TREATMENT applications in the coagulation of turbid and colored waters, the softening of hard well waters, or the simultaneous softening and clarifying of hard river waters, can all be accomplished, it is claimed, in a new clarifier introduced by Liquid Conditioning Corp., 423 West 126th St., New York 27, N. Y. This clarifier, shown in cross-section in an accompanying illustration, precipitates impurities through chemical treatment in the form of a sludge.



Liquon sludge contact reactor

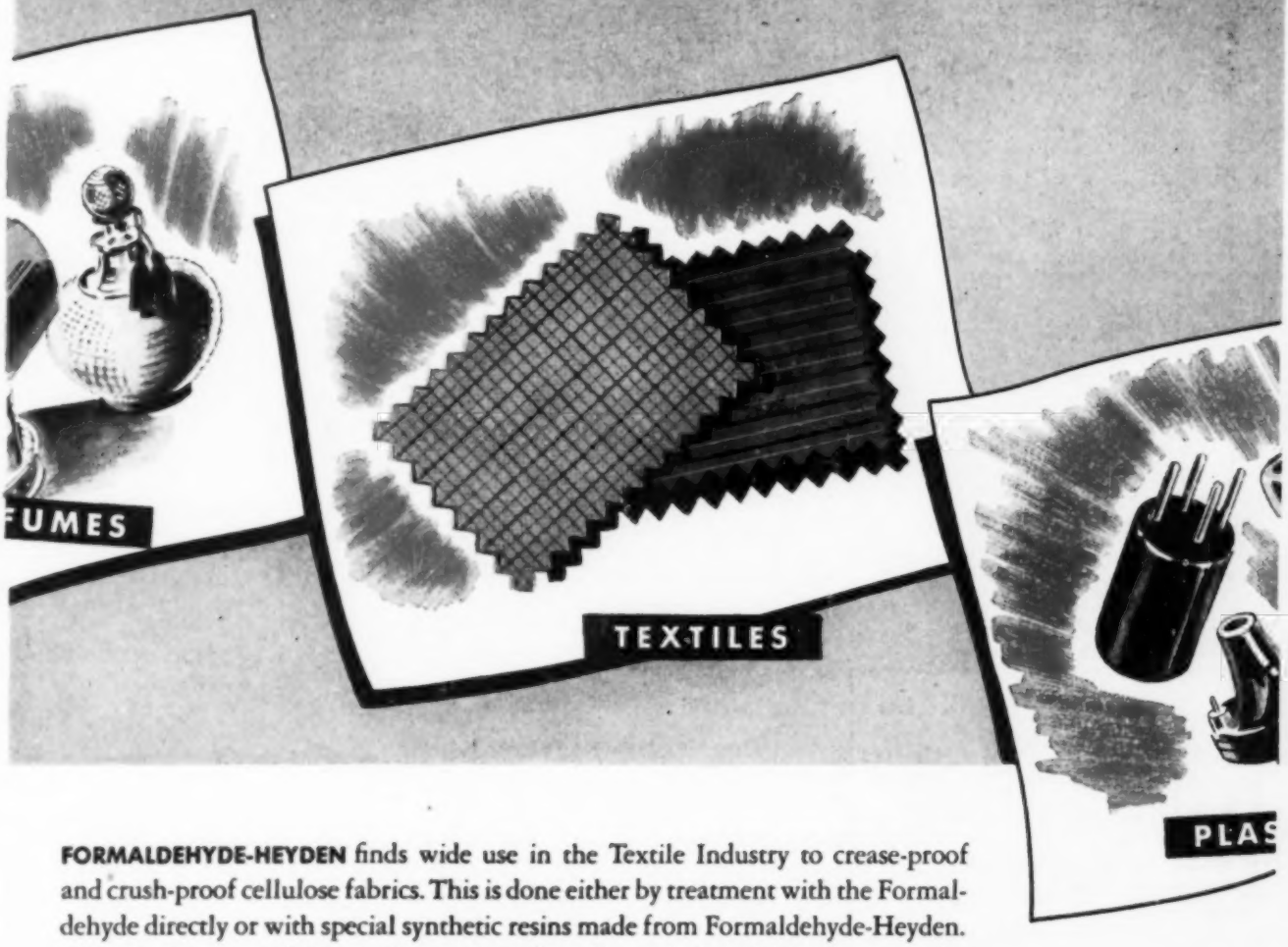
The coagulating and softening chemicals are positively recirculated, as indicated by the arrows in the illustration. Settling out and depositing of sludge on the floor of the tank is prevented by a large, slow-moving agitator which operates over the entire bottom of the tank. Clarified water is separated from the sludge by horizontal outward radial flow, with gradually decreasing velocity. This method is said to permit the use of smaller diameter tanks than in clarifiers employing up-flow through the sludge blanket. A sludge concentrator is provided to collect and considerably thicken some of the sludge for blow-off by automatic desludging, thus keeping the top of the suspended sludge at the optimum level for best chemical results consistent with the clear effluent.

Improved dry chemical extinguisher

DRY CHEMICAL EXTINGUISHER

FURTHER improvements in the dry chemical extinguishers of its manufacture have been announced by the Fire Extinguisher Division, Ansul Chemical Co., Marinette, Wis. The improved extinguisher is said to have greatly increased fire stopping power, simplified and faster operation, quicker and easier re-charge on the spot, greater heat shielding protection to the operator, and greater capacity without increased weight. This extinguisher, which carries approval of both Underwriters' Laboratories and

HOW Heyden Chemicals serve major Industries



FORMALDEHYDE-HEYDEN finds wide use in the Textile Industry to crease-proof and crush-proof cellulose fabrics. This is done either by treatment with the Formaldehyde directly or with special synthetic resins made from Formaldehyde-Heyden. These resins are used also in the coating of textiles—glazing chintz, for example.

FORMIC ACID-HEYDEN is widely used in the dyeing of fabrics. It makes possible more even dyeing and gives more complete exhaustion of the dye bath. Formic Acid is also a valuable scrooping agent to increase the lustre of artificial silk.

OTHER Heyden products used in producing textiles include Hexamethylenetetramine and Paraformaldehyde—for waterproofing chemicals; Parasepts and Sodium Benzoate as preservatives in sizing; Propyl Gallate as an antioxidant . . . and Benzoic Acid as a mordant.

Further information about these products, together with Technical Data Sheets, will be sent upon request.

HEYDEN

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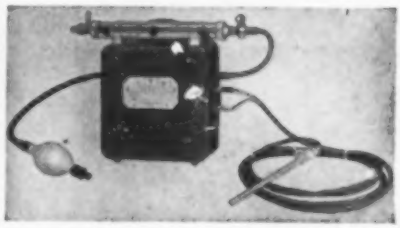
The Engelhard Flualizer



Complete Testing Unit

For checking CO_2 and flue gas temperture, the ENGELHARD FLUALIZER combines a thermocouple with a Wheatstone bridge, in a rugged, portable unit. Complete with aspirator bulb, a dryer, hose and all accessories. Weight only 8 lbs.

Write for descriptive Bulletin 700

Charles Engelhard Inc.

233 N.J.R.R. Ave., Newark 5, N. J.

• **FILTER CLOTH**

• **FILTER** PRESS SACKS ALL KINDS

WOVEN GLASS AND "DURAKLAD" (ACID RESISTANT)

• **FILTER FABRICS**

Made into all sizes and constructions. filter cloths, tubes, discs, gravity bags, centrifuge liners, rotary filters, flotation blankets, etc.

GLASS CLOTH FOR HIGH TEMPERATURES

is acid and alkali resistant, has a smooth, hard surface, free from lint, made into a wide variety of weaves and widths. Can be fabricated to meet your requirements.

VACUUM BAG & DUST ARRESTING TUBES

for all purposes

Send Sketch or Specifications of Material Required

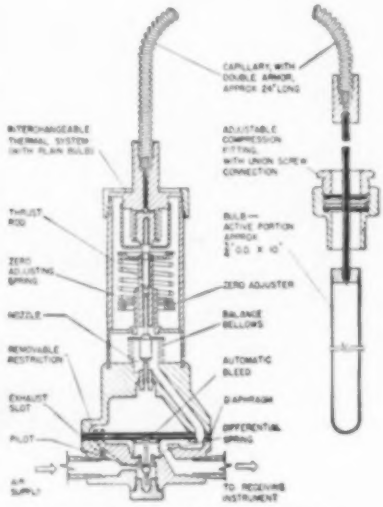
WM. W. STANLEY CO., Inc.

401 Broadway, New York 13, N. Y.

Factory Mutual Laboratories, is of the type in which a dry chemical is discharged by gas pressure.

REMOTE THERMOMETER

To ENABLE thermometers to produce the indications of the sensitive element at distances of 1,000 ft. or more from the thermometer bulb, without the use of long capillaries, Moore Products Co., H & Lycoming Sts., Philadelphia 24, Pa., has developed the Nullmatic thermometer, a gas-filled system employing a capillary only 24 in. long. The instrument operates on a pneumatic "null" balance principle, in which the pressure in the gas-filled thermal element



Pneumatic transmitting thermometer

is balanced by air pressure. The balancing air pressure is then transmitted to the remote indicator, recorder or controller.

The instrument employs interchangeable thermal elements, and it is pointed out that the pressure of the gas fill does not determine the operating range. Standard thermal elements with either of two filling pressures serve for temperatures as low as minus 150 deg. F., or as high as 800 deg. F. The operating range of any of these thermometers may be reset over wide limits by the use of a suppression adjustment in the transmitter which is also used for setting the zero. Standard instruments are furnished to operate over a variety of Fahrenheit temperature spans from 100 to 800 deg. F., or to 450 deg. C. It is claimed that the instrument will respond to temperature changes as small as 0.01 deg. F., and that temperature changes with a lag coefficient of only 2.4 sec. will be detected and transmitted. A transmission distance of 75 ft. does not affect speed of transmission, but about one second transmission time must be added for each additional 100 ft. of ¼-in. line.

PARTICLE PRECIPITATOR

PRECIPITATORS which will remove either solid or liquid particles from plant discharge gases are now being built for industrial use by the Koppers Co., Koppers Bldg., Pittsburgh 19, Pa. Known as the Koppers-Elex electrostatic precipitator, this equipment is being produced at the company's Bartlett-Hayward plant for the removal from gases of such contamination as fly ash, tar, acid mist, soda ash dust, fluorides, catalysts, and other nuisances or valuable by-products. The precipitator is a Swiss design, for which exclusive manufacturing and sales rights in North America have been acquired by Koppers.

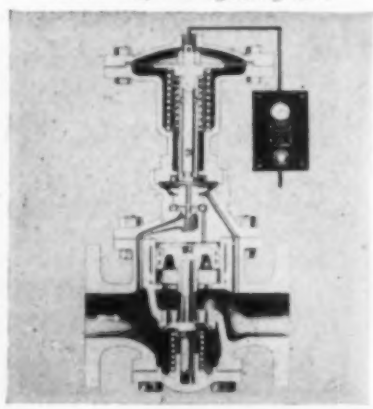
UNIT COOLING TOWER

CAPACITIES from 3 to 50 tons of refrigeration are provided in a new line of unit cooling towers built in ten sizes by Marlo Coil Co., 6135 Manchester St., St. Louis, Mo. These units, which are a modification of the company's evaporative condenser, are identical in dimensions with the latter, and are similar in construction, except that in place of a condensing coil, suitable wetted deck surface is used. Towers are provided with mechanical draft to make their performance independent of prevailing wind direction and velocity. It is claimed that all drift and objectionable spray carryover are prevented. Units are light in weight and sectionally built, making them suitable either for outdoor roof or indoor locations.

REGULATING VALVE

REMOTE adjustment is an important feature of a new single-seated, internal-pilot, piston-operated reducing valve recently announced by Leslie Co., 279 Grant Ave., Lyndhurst, N. J. Designated as Class LT-3, the valve includes a diaphragm which can be loaded with an air pressure adjusted at a remote air-loading panel. The latter includes a small combination pressure reducing and relief valve, together with

Remote adjusted regulating valve



AIR LINE RESPIRATORS

U. S. BUREAU OF MINES - APPROVED

Equipped with the Comfo Cushion Facepiece

NEW FLOATING CUSHION FACEPIECE with soft rolled edge assures quick gas-tight fit on persons of widely varying facial shapes and sizes.

UNIQUE BRIDGE STRAP provides comfortable, automatic adjustment across nose.

LOW RESISTANCE TO AIR FLOW is provided by twin, guarded exhalation valves.

BUILT-IN AIR DEFLECTOR assures comfortable air circulation in facepiece.

With the new Comfo Cushion Facepiece for greatest wearing ease, the M.S.A Air Line Respirator gives positive, complete respiratory protection against the many classes of air contaminants noted above. Here, really, is an ideal combination of protection plus comfort for the wearer!

The facepiece is connected to the air supply by a 30" flexible corrugated tube, designed to allow free head movement—will not shut off from kinking, chin or arm pressure A detachable coupling or quick release connection quickly attaches or detaches the respirator and air hose A replaceable chemical cartridge is incorporated in the quick release connection as standard equipment, acting as a secondary filter to remove traces of oil and dirt from the compressed air.

Bulletin CS-23 gives you full details. Write for your copy today!

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FOR THESE ATLAS FLOORS AND TANKS

"Down Time" and Maintenance don't enter into their Schedules!

Whatever your particular acid- and alkali-proofing problem, it can be solved with Atlas materials—corrosion-proof brick, tile, cement, linings and coatings. Note that these materials are *proof* against *(not merely resistant to)* every type of industrially used corrosive.

Units designed and produced by Atlas include tanks, floors, ducts, stacks and neutralizing and disposal pits. These Atlas units are serving in many of America's largest chemical and steel plants. Atlas service is complete, covering everything, including design, materials and supervision, and installation if desired.

Contact an Atlas representative at the nearest branch office. Put your problem up to him. Back of him stands our Engineering Division with wide experience covering every industrial field—ready to serve you with recommendations, plans and estimates. No obligation.

Write our Mertztown Office for Technical Bulletin No. TB-1.

Rubber lined steel and red Atlas brick and Tegul-VITROBOND linings like these—in service for eight years and more are doing yeoman's work in chemical service handling sulphuric and phosphoric acids.*

This floor of white Atlas Brick and ALKOR has withstood years of service under the attack of organic solvents, greases, inorganic acids and alkalis without a stop for maintenance, repairs or replacement.*

**Tegul-VITROBOND is a plasticized sulphur cement. ALKOR* is a synthetic resin, alkali- and acid-proof cement.*

THE Atlas Mineral

PRODUCTS COMPANY OF PENNA.

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*DETROIT 2, Mich., 2970 W. Grand Blvd.	ST. LOUIS 8, Mo., 4485 Olive St.
NEW YORK 16, N. Y. 280 Madison Ave.	

THE ATLAS MINERAL PRODUCTS CO. OF TEXAS, INC. Box 252, Houston 1, Texas

DALLAS 5, Tex., 3921 Purdue St.	*KANSAS CITY 2, Kan., 1913 Tauromee Ave.
*DENVER 2, Colo., 1921 Blake St.	*LOS ANGELES 12, Cal., 172 S. Central Ave.
*HONOLULU 2, Hawaii, U. S. A., Lewers & Cooke, Ltd., P. O. Box 2930	*SAN FRANCISCO 3, Calif., 244 Ninth St.
	*SEATTLE 4, Wash., 1232 First Avenue, S.

**Stock carried at these points*

IN CANADA: Atlas Products are manufactured by H. L. BLACHFORD, Limited, 977 Aqueduct Street, Montreal, P. Q.

an adjusting knob and an air-pressure gage. In operation the regulating valve is adjusted to the desired pressure setting by regulating the air pressure supplied by the air-loading panel. The constant loading force on the valve's upper diaphragm opens the latter's controlling valve and is balanced by a constant reduced pressure proportional to the loading force, thereby maintaining a constant reduced output pressure. This arrangement is said to be particularly suitable for process piping arrangements that require hazardous or inconvenient readjustments of inaccessibly located valves.

CLAMP TRUCK

AN INDUSTRIAL truck designed to handle light and bulky cartons as unit loads without requiring pallets or skids is being offered by Automatic

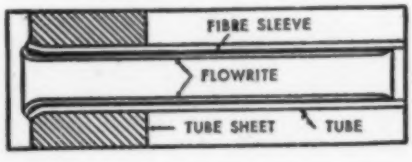
Clamp truck for light cartons

Transportation Co., 149 W. 87th St., Chicago 20, Ill. As appears in the accompanying illustration, this truck is a modified version of the company's standard fork truck which, instead of the usual forks, employs a pair of hydraulically operated pincers to grab a load of cartons from the sides and lift them for loading, unloading, or stacking. The clamping pads, which are adjustable in height, are mounted on a scissors-like frame opened by an hydraulic pump. Release of the hydraulic pressure allows the springs to pull these clamps together, grasping the load between them.

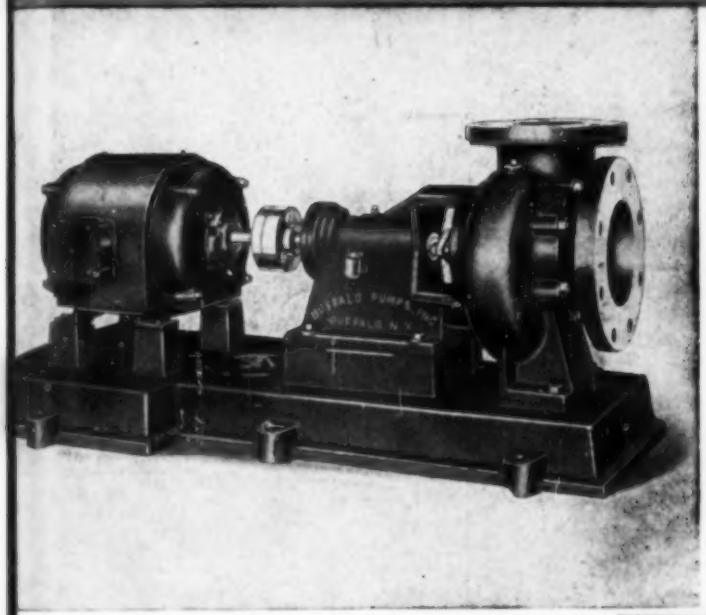
CONDENSER IMPROVEMENTS

Two NEW devices to improve use and maintenance of condensers have been announced by Condenser Service & Engineering Co., Hoboken, N. J. The first of these is the new Fiberclad Flowrite, which is used to protect condenser tube inlet ends against erosion and to prevent leakage even though tubes may be eroded badly at

Fiber-clad tube end insert



ACETIC ACID TO ZINC SULPHATE
PUMPING EFFICIENCY



WITH "Buffalo"

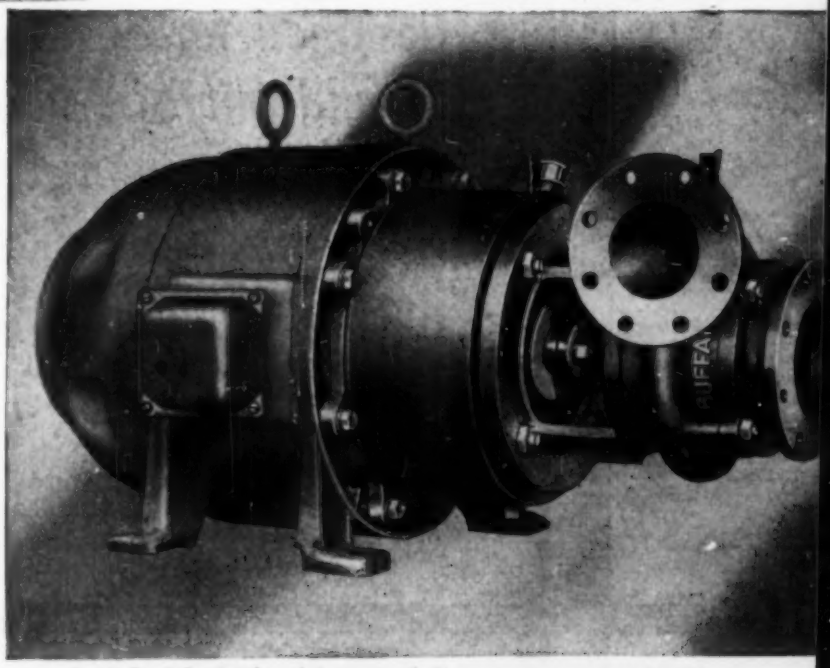
CHEMICAL SERVICE
PUMPS

ffalo Chemical Pumps such as this Class "CS" may "tailored" to each job by the proper lead or alloy ings . . . assuring the utmost service life and ficiency for the particular liquid pumped. Write for ulletin 982.

Corrosive liquids, slurry, acids, gritty ids and all kinds of temperatures are con- ally confronting operators responsible for ping performance in chemical installations. Yet operators can avoid premature wear other pumping "headaches" by ordering the "Buffalo" Pump. For practically every id handled, there is a husky, high-delivery ffalo" Pump of the proper alloy, lead or er construction to give you *added years* of ble-free service.

Why not write us about your problem, de- ing liquids pumped, heads, temperatures, We'll be glad to make cost-cutting recom- dations.

BUFFALO PUMPS, INC.
Broadway Buffalo, N. Y.
Canada Pumps Ltd., Kitchener, Ont.



CRAMPED FOR SPACE? A rugged, compact Buffalo Close-Coupled Pump may be just your answer. For the many types of liquids it handles, all performance and construction details, simply write for Bulletin 975-B.

"Buffalo"

"CS" AND "CC"
PUMPS

Lifts, carries, tiers, loads of 1000 lbs. to 84"

CLARK TRUCLOADER

—light, compact, fast, designed for operating in and out of trucks, trailers, low-capacity elevators and general material handling operations. Gas and electric powered.

TO SEE CLARK TRUCLOADERS AT WORK IN BUSINESSES LIKE YOURS SEND FOR NEW PICTORIAL LITERATURE.

CLARK TRUCTRACTOR

Division of CLARK EQUIPMENT COMPANY

BATTLE CREEK, MICHIGAN

OTHER PLANTS — BUCHANAN, JACKSON, BERRIEN SPRINGS, MICHIGAN

Other CLARK Products

FORK LIFT TRUCKS
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DRILLS & GEARS

ELECTRIC STEEL CASTINGS
METAL SPOKE WHEELS
AXLES & HOUSINGS
TRANSMISSIONS

Prices on CLARK products will not be advanced in excess of increased costs.

the time of installation of the new devices. For many years this company has offered metal belled-end tube inserts for the purpose indicated. The new type consists of such a metal tube with a thin fiber sleeve shrunk on the outside. Installation of the new type is simple, requiring no cement and no special care. After installation the fiber swells in contact with the water to produce an extremely tight seal. These devices gives a venturi action and are said to have been shown in an impartial test to reduce water friction at the tube entrance up to 80 percent.

Another new device developed by this concern is a simple detector for condenser tube leaks. This consists of a rubber body, one end of which is conical to fit into a condenser tube, with the other end a thin-walled bulb. An air passage connects the bulb with the conical end and a knurled metal sleeve surrounds the body to provide a hand grip. To test a tube one end is plugged, while the shell space is under vacuum. The tube tester is then inserted into the other end of the tube. If the bulb is sucked in the tube leaks. Penetrated tubes are thus quickly and positively located.

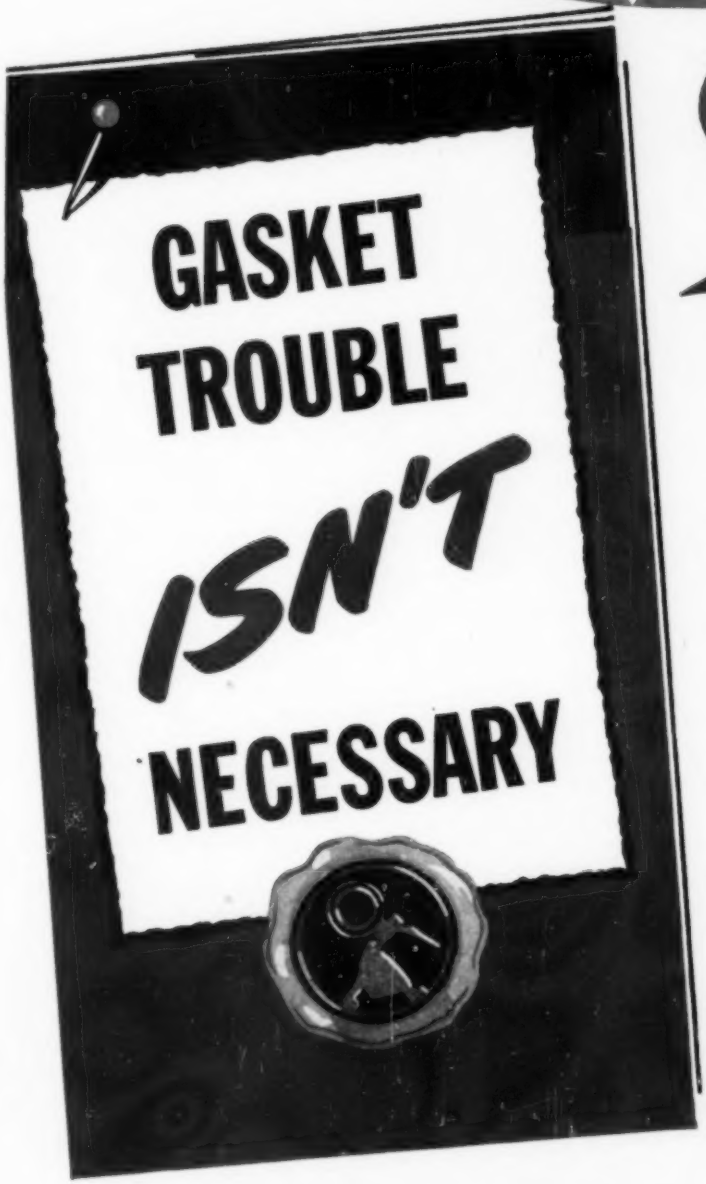
HIGH-LIFT TRUCK

AN ELEVATING reach of 18 ft. above floor level is obtainable with a new fork-type industrial truck an-

Fork truck elevated to 18 ft.

nounced by Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 14, Ohio. Standard models heretofore have had a lifting range up to 10 and 12 ft., with a few special models going as high as 16 ft., according to the manufacturer. The new truck picks up loads on bare forks or on pallets, as with standard models. Its capacity is rated at 4,000 lb. for lifting to heights of 11 ft., and 3,000 lb. to 18 ft. With capacity load the lifting speed is 13 ft. per min., and the lowering speed 20

Are you getting the GASKET SERVICE You Ought to Get?



If you take gasket troubles for granted, here's a fact that you should know—

Most of those troubles are unnecessary.

Why? Because you're using a gasket that's *almost* right for its particular application. By getting the gasket that's *exactly* right, you get maximum durability, and *100%* joint efficiency.

To eliminate these unnecessary troubles, let the experience of the Goetze research laboratories help you survey your gasket applications. They can recommend the gasket that exactly suits your particular conditions of temperature, pressure or corrosion, and you can probably get the gasket from the regular Goetze line—the only complete line of metal gaskets. If you need something special, Goetze engineers may be able to develop a special gasket for you.

We invite your inquiries—what are your problems? Give us the details on your company letterhead, or get in touch with the nearest Goetze representative.

GOETZE GASKET & PACKING CO., INC.

45 ALLEN AVENUE, NEW BRUNSWICK, NEW JERSEY

Boston	Cleveland	Detroit	Chicago
Cincinnati	San Francisco	Los Angeles	Buffalo
Houston	Philadelphia	Pittsburgh	Denver
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	Toronto	Syracuse	

Lowell Thomas Speaks On New Gasket Film

Now available to employee groups, technical societies, engineering schools and other organizations throughout the country, this new 35-minute Kodachrome film, "Only a Gasket," tells why these are the "Biggest little things" in modern industry. Write for full information.

Goetze for GASKETS

"America's Oldest and Largest Industrial Gasket Manufacturer"

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FIRE-FOG
• IT BLANKETS • IT ISOLATES • IT QUENCHES •

— a famous member of the "Automatic" Sprinkler Family. Provides adequate protection for quench tank, transformer, oil line and other fires of flammable liquid origin.

IF you're planning new construction or the remodeling of your existing facilities, adequate defense against fire must receive primary consideration. For the very structure of business enterprise is dependent upon continuity, and *fire can destroy that continuity with deliberate suddenness.*

Today's business executives are aware more than ever before of the wisdom of safeguarding lives and property. They, too, are quick to recognize the advantages of "Automatic" Sprinkler protection, industry's most effective weapon against fire . . . and this recognition did not come overnight. It is the result of more than half a century of pioneering and leadership in the design, engineering, and construction of approved fire extinguishing devices and systems which *must* and *do* meet the approval of all leading fire insurance bureaus.

• Want further information on automatic sprinkler protection? Your telephone will quickly reach an "Automatic" Sprinkler Engineer located in the principal cities of North and South America, or write "Automatic" Sprinkler Corporation of America, Youngstown 1, Ohio.

"Automatic" Sprinkler devices and systems are listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories.

FIRE PROTECTION
DEVELOPMENT ENGINEERING
"Automatic" Sprinkler
MANUFACTURE INSTALLATION
"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA
YOUNGSTOWN 1, OHIO
OFFICES IN PRINCIPAL CITIES OF NORTH and SOUTH AMERICA

ft. per min. The truck is electric-powered, using separate motors for traveling, operating the elevating mechanisms, and tilting. The truck is controlled from the rear end with controls arranged for maximum convenience. The extreme lift permits using high storage space not previously available.

FACE SHIELD

EXTRA OVERALL protection in the handling of chemicals, including acids, oils and alkalies, as well as protection against hot water and

Face shield for chemical protection

flying particles, is afforded by a new face shield having an extra large window, 18¾ x 10 in. in size, made from cellulose acetate of 0.04 in. thickness. This shield extends completely around the face, even covering the ears. The fiber head guard protects the upper forehead and covers the entire top of the head as an additional safeguard. The headgear band slides within a fiber sleeve in back to permit easy adjustment to varying head sizes, while a metal knob allows for quick adjustment. Positive friction joints hold the window securely in "on" or "off" guard position.

EQUIPMENT BRIEFS

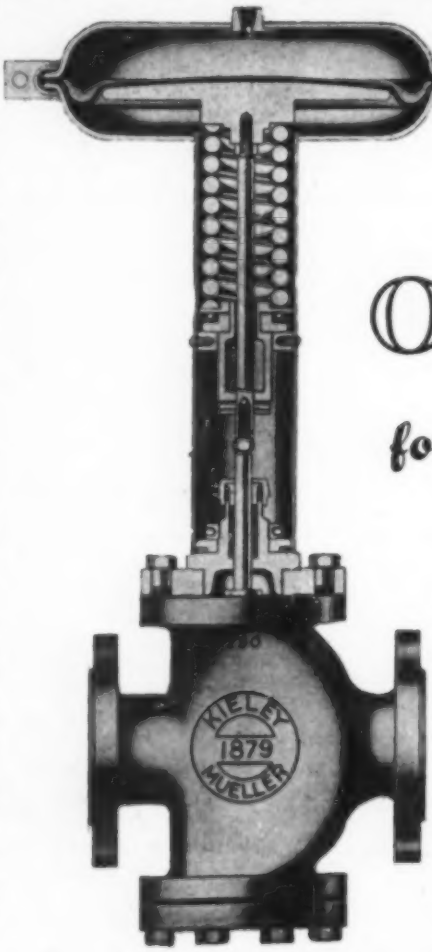
A CAPACITY of 10 g.p.m. at normal cranking speed is claimed for a new vane-type rotary hand pump employing an aluminum rotor with graphite carbon vanes and stainless steel springs, that has been announced by the Industrial Pump Division of Bowser, Inc., Fort Wayne, Ind. The suction and discharge ports are threaded for ¾-in. iron pipe.

A NUMBER of further improvements in electronic controls for pulverizer feed have been announced by Mosher Electronic Controls, 130 West 42nd St., New York 18, N. Y. A new principle, designated as Amplified Signal, does away with mechanical adjustment of critical relays through the use of electrically regulated vacuum tubes.

for ACIDS...

WILFLEY **is the dependable pump that takes the trouble out of handling acids, corrosives, hot liquids, mild abrasive and other tricky solutions. It's the pump that runs continuously on a 24-hour schedule without attention. Works on intermittent as well as continuous operations. 10- to 2,000-G.P.M. capacities, 15- to 150-ft. heads and higher. Individual engineering on every application. WILFLEY is the pump to buy when you're seeking economy and efficiency. Write or wire for details.**

A. R. WILFLEY & SONS, INC.
DENVER, COLORADO, U.S.A.
New York Office: 1775 Broadway, New York City



OPEN

for inspection...

It's easy . . . any time . . . for inspection or maintenance. Just two clamp screws to open and the diaphragm casing is off. Just open the door in the yoke and the spring adjustment and stuffing box are exposed.

For other equally important new features of the revolutionary new K & M KONTROL MOTOR, check this list:

- **Pressed steel Diaphragm Casing . . . lighter . . . tougher.**
- **Rigid Welded Steel *Tubular* Yoke.**
- **Duo-seal molded diaphragm provides high travel, uniform loading.**
- **Long calibrated Steel spring . . . fully enclosed.**
- **Enclosed ball bearing spring adjusting screw.**
- **Streamlined Flow Valve Body for high capacity . . . unrestricted flow areas.**
- **Super finished Inner Valve Guides, *honed* guide bushings, top and bottom . . . for minimum friction; increased life.**

KONTROL KIELEY & MUELLER MOTOR

2033 43rd St., North Bergen, N. J.

Represented in

NEW YORK CITY
DETROIT
CINCINNATI
HOUSTON
LOS ANGELES
ROCHESTER
PITTSBURGH
TULSA
NEW ORLEANS
SAN FRANCISCO
CHICAGO
BALTIMORE
DALLAS
DENVER
PORTLAND

While the control is said to be sensitive to all changes in rate of feed to the grinder, it is unaffected by fluctuations in power line voltage.

UNITED STATES RUBBER Co., Rockefeller Center, N. Y., has announced an improved hose for unloading trucks and tank cars of oil and gasoline for which lighter weight, increased flexibility and greater toughness are claimed. The carcass consists of two plies of Ustex, a chemically treated textile 70 percent stronger than conventional cotton yarn, which replaces the three plies of cotton formerly used. The lining is synthetic rubber.

RICHARDSON SCALE Co., Clifton, N. J., is again manufacturing its friction-drive bag closer, which was discontinued during the war. The machine, which is hand-operated without power, is distributed exclusively, as previously, by Bemis Bros. Bag Co., St. Louis, Mo.

SUPER-HIGH-SPEED counting at speeds as high as one million per second, is claimed for the new electronic time interval counter developed by the RCA Engineering Products Dept. of Radio Corp. of America, Camden, N. J. This equipment is said to be suitable where speed requirements are too fast for conventional counters. It can, for example, be used for high speed counting and enumerating objects passing rapidly on a continuous conveyor belt or counting the number of drops of liquid falling from viscosity testing apparatus. It is said to be suitable for pill counting operations in packaging of drugs.

NO PARTS requiring maintenance, and no vacuum tubes requiring replacement, are used in the new type 15GK1 Fireye boiler feedwater control that is now being offered by Combustion Control Corp., 77 Broadway, Cambridge 42, Mass. This device is an alternating current control that combines a probe circuit and a transformer in such a way as to operate a direct current relay through a rectifier. Direct current is used in the relay circuit to eliminate chatter and increase contact pressure, making possible the use of low alternating current voltages in the probe circuit. Electrolysis is claimed not to take place. Closure of the probe circuit alters the magnetic field of the transformer in such a way that current is generated in the rectifier-relay circuit to energize the relay. Three probes are used, two of which define the high and low water levels, with the third an emergency control which shuts off the fuel supply and sounds an alarm should water drop that low.

NEW PRODUCTS AND MATERIALS

Richard W. Porter, ASSISTANT EDITOR

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HIGH-TEMPERATURE INSULATION MATERIAL

DEVELOPED for use on jet aircraft engines, a high temperature insulating material that is both efficient and light in weight is now available from the H. I. Thompson Co., 1733 Cordova St., Los Angeles, Calif. Having the brand name of Refrasil, this insulation is a fibrous material composed of essentially pure silica and is commercially available in bat form or as a woven cloth. It is now being produced in commercial quantities and might well warrant investigation for applications in a variety of industries. It is claimed to have possibilities for insulating high temperature equipment and piping and might also be used as a filtration medium where chemical resistance and inertness are required. It may also find application in the electrical field as insulation.

Refrasil bat is a white felted fibrous material composed of high silica content fibers and is available in rolls approximately 14 ft. long, 3½ ft. wide and ⅛ in. thick. It has an approximate surface density of 0.05 lb. per sq.ft. and an average bulk density of 4 lb. per cu.ft. It does not have a sharp melting point. The fibers start to soften at about 2,300 to 2,400 deg. F. and are fused together at temperatures of about 3,100 deg. F. Maximum recommended temperature for continuous use is 2,000 deg. F. although for short periods temperatures up to 2,500 deg. F. are permissible. Refrasil has a negligible shrinkage when heated to 2,000 deg. F. Moisture content is negligible and moisture pickup at the high temperatures is low. Absorption of moisture at 70 deg. and 90 percent humidity is approximately 15 percent.

This insulation material is claimed to have good chemical stability and is unaffected by ordinary acids and alkalis. Although the fibers which have an average diameter of 0.00023 in., have a rather low tensile strength, they stand up well under high frequency and high amplitude vibrations. Specific heat of Refrasil is 0.19 which, coupled with the low density of the material, gives a low thermal capacity. Where the bulk density is 4 lb. per cu.ft. the thermal capacity per square foot of 1-in. thickness is 0.063 B.t.u. per deg. F. It is a good heat insulator. At low temperatures it compares favorably with the best low temperature insulation materials and at high temperatures it has only one-third the thermal conductivity of many standard materials.

Refrasil cloth is a white woven cloth available in rolls of random length approximately 32 in. wide. Its thickness is 0.015 in. Properties are similar to those outlined for the material in bat form. Other forms of Refrasil such as tapes, cords and sleevings are being produced in experimental quantities at the present time.

CARBON ISOTOPE

COMMERCIAL production of a heavy isotope of carbon, C^{13}, for tracer purposes has been announced by the Research Laboratories of the Eastman Kodak Co., Rochester, N. Y. Laboratory production has been under way for some time; operation has now reached a point where it is possible to make the first commercial shipment of C^{13} in the 20 to 25 percent concentration range. Initial production is on a small scale only, but larger fractionating columns have been installed and will be in operation in the near future. At present, all concentrations of the material above 18 percent are being supplied to the American Cancer Society but small amounts of the material produced at lower concentrations will be available for regular commercial distribution. Initially, the C^{13} will be available as potassium cyanide, although it is expected that synthetic organic compounds will ultimately be available containing C^{13}.

ORGANIC INTERMEDIATES

OFFERING promise as an intermediate in the preparation of various organic chemicals, *p*-di-tert-butylbenzene is now available as a research chemical, from the Chemical Products Department of the Standard Oil Co. (Ind.), 910 South Michigan Ave., Chicago 80, Ill. This new chemical is a white crystalline solid and has the properties and composition given in the accompanying table. Impurities present include tert-butylbenzene, m-di-tert butybenzene, and higher boiling point alkylbenzenes.

Typical Properties and Composition of p-di-tert-Butylbenzene

Freezing point, deg. C	76.3
Boiling point, deg. C at 760 mm.	235.8
Bulk density, g. per ml.	0.6
Purity (wt. percent p-di-tert-butylbenzene)	98.5
Ash, wt. percent	none
Acid value, mg. KOH per g.	greater than 0.1

Solubility (g. per 100 ml. of solvent)

	25 deg. C.	65 deg. C.
Alcohol (95 percent)	2.2	34
Ethyl ether	55	
Benzene	75	42
Carbon tetrachloride	95	585
Water	nil	nil

This new chemical is suggested as an intermediate in preparation of various organic chemicals through nitration, sulphonation, oxidation, and other reactions in the production of a variety of products of interest to the chemical, dyestuffs, paint, plastics, synthetic fiber, textiles, pharmaceutical and perfume industries. It is also suggested for use as an intermediate in the production of additives such as anti-oxidants for a variety of industries. It is available in ¼, 1 and 5 pound containers.

VARNISH RESIN

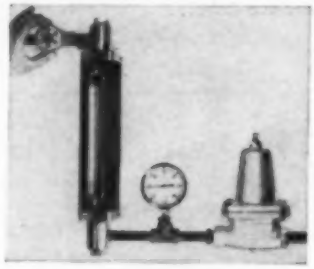
ANNOUNCED by the Neville Co., Pittsburgh 25, Pa., is a new oil-reactive, fortifying type resin which is claimed to extend drying oils 50 to 100 percent without impairing film strength, durability or adhesion. Known as Nevillac RT, this material is classified as a semi-phenolic, semi-oxidizing resin, entirely free from rosin, rosin ester, mineral or oleoresinous oil, formaldehyde, or any diluting ingredient. From the standpoint of water and weathering resistance, it has similarities to conventional "pure" phenolic type resins. Nevillac RT is claimed

SULFITE-ing Simplified with ANSUL SULFUR DIOXIDE

ANSUL SULFITE-ing METHOD IS THE ACCEPTED REPLACEMENT FOR SULFITES, BISULFITES AND METABISULFITES IN INDUSTRIAL PRACTICES.

METHOD ONE

● Industrial users of sulfites and bisulfites . . . interested only in obtaining the action of the SO_2 content of the salt . . . can eliminate costly, time-consuming operations with an easy-to-install-and-operate Ansul finger-tip control SO_2 system.



An Ansul finger-tip control SO_2 system is easy and economical to install and operate. It provides a regulated supply of pure SO_2.

Ansul Sulfur Dioxide is inexpensive and readily available.

METHOD TWO

● When it is essential to use a sulfite, bisulfite or metabisulfite, it may be more economical and more efficient to make it on the job by mixing specified amounts of alkali or other basic compounds with water solutions of Sulfur Dioxide.

Ansul technicians will willingly co-operate with you in setting up an Ansul Sulfite-ing system in your plant. Write for additional information and ask for your copy of the booklet "Liquid Sulfur Dioxide."

Liquid Sulfur Dioxide ANSUL*

PHYSICAL PROPERTIES

Chemical formula	SO_2
Molecular weight	64.06
Color (gas and liquid)	Colorless
Odor	Characteristic, pungent
Melting point	−103.9° F. (−75.5° C.)
Boiling point	14.0° F. (−10.0° C.)
Density of liquid at 80° F.	(85.03 lbs. per cu. ft.)
Specific gravity at 80° F.	1.363
Density of gas at 0° C. and 760 mm.	2.9267 grams per liter (0.1827 lb. per cu. ft.)
Critical temperature	314.82° F. (157.12° C.)
Critical pressure	1141.5 lbs. per sq. in. abs.
Solubility	Soluble in water
Purity	99.9+% (by wt.) SO_2 (H_2O less than 0.01%)

*REG. U.S. PAT. OFF.

For your METHYL CHLORIDE *applications . . . . Use* ANSUL METHYL CHLORIDE

ANSUL CHEMICAL COMPANY
INDUSTRIAL CHEMICALS DIVISION, MARINETTE, WIS.
Eastern Office: 60 E. 42nd St., New York City

to impart improved durability of varnishes; to improve water resistance of oleoresinous coatings; eliminate skinning; and to assure color fidelity and freedom from after-yellowing. It is also claimed to improve gloss and fullness. Evaluation of this chemical plasticizer for more than two years in laboratory and industrial use has established its strong fortifying action, resulting in dry films which behave as if they contained up to double their actual drying oil content. The optimum amount of Nevillac RT required varies with the oil content, but is roughly 9.4 percent by weight of the oil. The balance of the resin requirement can be any one of a large number of conventional varnish resins.

INSECTICIDE TOXICANT

AVAILABLE in experimental quantities only to qualified testing agencies is a new insecticide toxicant recently announced by Hercules Powder Co., Wilmington, Del. Under the brand name of Toxaphene this material has been shown through preliminary tests to be as effective as DDT against certain insects and more effective against others. Toxaphene is a chlorinated camphene, and is prepared in eight different forms: technical grade, 25 percent wettable powder, 25 percent oil soluble concentrate, 50 percent water miscible concentrate, 10, 20, and 50 percent dust concentrates, and Thanite plus Toxaphene. This material has been undergoing extensive tests for almost two years in more than 75 different locations throughout the country. These extensive tests indicate that it can be used effectively in agricultural, household, and industrial insecticides. It is reported to be effective against such insect pests as cotton insects, tobacco horn worm, Mexican bean beetle, flies, clothes moths, and roaches. Toxaphene may be combined with Thanite, a Hercules toxicant possessing quick knockdown properties, for use where both quick knockdown and residual properties are desired.

ETHYL VINYL ETHER

LIMITED quantities of ethyl vinyl ether are now available for research and development purposes from the General Aniline & Film Corp., 230 Park Ave., New York 17, N. Y. This product is the result of extensive research carried on by this company in high pressure acetylene reaction. Ethyl vinyl ether may be used as an anesthetic similar to ethyl ether or as an intermediate in chemical syntheses in the pharmaceutical and other branches of the chemical industry. It may be converted to polymers and copolymers for use as lacquers, coatings, and textile and paper finishes. The vinyl ethers are

A Thought for the New Year

FOR PROLONGING LIFE
IN CHEMICAL ENGINEERING
EQUIPMENT—NOTHING EQUALS
STAINLESS STEEL

▶ In every chemical plant where the elimination of corrosion is a "must" — not only for the prevention of equipment deterioration, but for minimizing product losses—Stainless Steel offers a practical and economical solution.

No other commercial metal can equal Stainless Steel in its high resistance to so many types of corrosives. None is more versatile in its application possibilities.

Today's demands for capacity production make it imperative to take the fullest advantage of the well-proven benefits that Stainless Steel, in its many analyses and various forms, has to offer the chemical industry.

In U·S·S Stainless Steel—a perfected, time-tested product—you can obtain all the superior properties of Stainless at top perfection.

To insure consistently exact and uniform quality, U·S·S Stainless is produced on special equipment under the close and precise control of skilled and experienced men who make stainless steel *only*.

Their entire attention is devoted to constantly perfecting its characteristics, improving its performance and widening the scope of its application. No other manufacturer can offer you Stainless Steel in such a *complete* range of forms, sizes and finishes in so many different analyses.

U·S·S STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
NATIONAL TUBE COMPANY, *Pittsburgh*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
United States Steel Supply Company, Chicago, *Warehouse Distributors*
United States Steel Export Company, New York
7-23

USS STAINLESS STEEL UNITED STATES STEEL

UNITED STATES STEEL

There is a LUBRIPLATE Dealer near you . . . at the other end of your local telephone. He stands ready to prescribe the LUBRIPLATE Lubricant that will make your machinery last longer, run smoother and produce more product at less cost. He has a complete stock on hand to give you prompt delivery. Give him a ring.

LUBRIPLATE

Lubricants definitely reduce friction and wear to a minimum. They lower power costs and prolong the life of equipment to an infinitely greater degree. LUBRIPLATE arrests progressive wear.

LUBRIPLATE

Lubricants protect machine parts against the destructive action of rust and corrosion. This feature alone puts LUBRIPLATE far out in front of conventional lubricants.

LUBRIPLATE

Lubricants are extremely economical for reason that they possess very long life and "stay-put" properties. A little LUBRIPLATE goes a long way.

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FISKE BROTHERS REFINING CO.

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DEALERS FROM COAST TO COAST

CONSULT YOUR CLASSIFIED TELEPHONE BOOK

suggested for use as raw materials for lubricating oil additives, rubber chemicals, adhesives, and waxes. The three vinyl ethers which have been announced previously by this company are methyl vinyl ether, isobutyl vinyl ether and n-butyl vinyl ether.

COMMERCIAL ANTIMALARIAL

COMMERCIAL production of Aralen, a new antimalarial, was recently announced by the Winthrop Chemical Co., Inc., 170 Varick St., New York, N. Y. It is available in tablet form containing 0.25 grams of chloroquine previously announced under its laboratory number SN7618 by the National Research Council. This material was first synthesized by Winthrop in 1944, and experimental quantities were turned over to the National Research Council for testing. It was one of several thousand chemicals tested as possible antimalarials by this agency. Aralen is available in tubes of ten tablets for a list price of $0.73, in bottles of 100 at $6.25, and bottles of 1,000 at $47.92.

ONE-WAY LABEL

IN ADDITION to the line of self-adhesive Kum-Kleen labels manufactured by Avery Adhesive Label Corp., 36 West Union St., Pasadena 1, Calif., the new "self-destroying" label is especially designed for trademarks, underwriter's approval, and similar factory-applied data. This new label overcomes the danger of anyone removing the label from a genuine product and placing it on substitute merchandise. The unique self-destroying feature is accomplished by die cutting the label so that it can be removed only in segments. The die marks, however, are impressed in such a manner that they are virtually invisible and in no way affect the design on the label. It may be applied to metal, plastic, wood, varnish, glass or cellophane. This label will adhere permanently despite heat, cold or humidity.

WOOD BONDING ADHESIVE

A PHENOL-TYPE adhesive, developed by the Casein Co. of America, Div. of the Borden Co., 350 Madison Ave., New York 17, N. Y., is especially formulated for bonding wood with radio-frequency equipment. Known as Cascophen RS-228, the product is claimed to eliminate some of the difficulties involved in gluing with dielectric heat. It does not arc when electrodes come in contact with the squeeze-out of glue or with the glue line itself. At the same time, Cascophen RS-228 allows the use of maximum power to provide quicker curing. This makes the radio-frequency method practicable for many new wood bonding operations.

The Zenith Pulp Press, with capacity up to 26 tons per hour, thoroughly dewaters wet pulps and slurries such as:

Beet Pulp • Citrus Wastes • Tomato Pomace • Cherries • Corn Fibre • Paper Pulp • Reclaimed Rubber, etc.

Heavy screw-type spindle applies smooth, continuous pressure, forces pulp or slurry against selective resistance. Rifle drilled resistors permit use of steam when necessary. Minutely perforated screens assure efficient drainage, hold pulp losses to minimum. Ball thrust bearings and oversize shaft bearings reduce power load.

New uses for the remarkably efficient, profitable Zenith Pulp Press are being constantly developed. An experimental press is available for trial in your plant.

Write for full information.

JACKSON & CHURCH CO.
SAGINAW, MICHIGAN

CHEMICAL ENGINEERING NEWS

AMERICAN ENGINEERS WILL JOIN WORLD CONFERENCE

PARTICIPATION of American engineers in a permanent World Engineering Conference, with headquarters in Paris, was disclosed by Clarence E. Davies, secretary of The American Society of Mechanical Engineers, at a business session of the Society's Annual Meeting last month. The new world technical body will have a practical working contact with the United Nations Educational, Scientific and Cultural Organization.

The Committee on International Relations of the Engineers Joint Council is the medium for organizing American participation. Its chairman is Malcolm Pirnie and its secretary is Stewart E. Reimel, with headquarters in the Engineering Societies Building, 20 West 39th Street. It plans to set up a national committee, with all United States engineering societies invited to be represented, as soon as formal sanction is received from the Council.

MAGNESIUM ASSOCIATION AND AIR FORCES SPONSOR SHOW

ARMY AND NAVY designing and engineering personnel, by official request will assemble at Wright Field, Dayton, Ohio, to attend a Magnesium Exhibit sponsored jointly by the Army Air Forces and The Magnesium Association, February 4-6. Invitations have also gone out to 3,000 leading industrial executives and engineering representatives.

Lt. General N. F. Twining, USA, Commanding Officer, Wright Field, Air Materiel Command, in conjunction with member companies of The Magnesium Association, is arranging a comprehensive demonstration of present practices and latest developments in magnesium technology. In addition to industrial exhibits, there will also be exhibits by the Army and the Navy.

NEW HEYDEN CAUSTIC PLANT OPERATING IN MEMPHIS

PRODUCTION of chlorine, caustic soda and hydrogen at the new Memphis, Tenn., plant of the Heyden Chemical Corp. is now under way. Annual capacity of the plant is 14,000,000 lb. of chlorine, 30,000,000 pounds of liquid caustic soda and 75,000,000 cu. ft. of hydrogen. In the near future, the plant is expected to begin production of chlorbenzene. At a later date, phenol is scheduled to be produced through use of a chlorbenzene and high-temperature caustic hydrolysis process.

The Heyden Corp. recently purchased the factory from the War Assets Administration for $1,060,000 and is considering an expansion program. Located on a 68-acre site within the Memphis city limits, the plant was built during wartime to produce phenol but never put into operation.

SULPHITE LIQUOR ALCOHOL PLANT IS SOLD

SALE of the DPC sulphite liquor alcohol and byproducts plant, Bellingham, Wash., for $450,000 to its wartime operator, Puget Sound Pulp & Timber Co., has been announced by WAA. Built in 1944 by RFC at a cost of $1,134,800, the plant, only one of its kind in the country, manufactures industrial ethyl alcohol in a specially designed process from sulphite waste liquor. The plant has a daily rated capacity of 6,140 gal. of 190-proof alcohol plus about 675 gal. of methyl alcohol and small quantities of fusel oil.

A large producer of unbleached sulphite wood pulp, Puget Sound Pulp & Timber Co. utilizes waste sulphite liquor from its own adjoining pulp mill for operation of the plant. The company also has indicated that improvements will be made and operations expended to include manufacture of denatured alcohol.

CARBIDE AND CARBON SALES SYSTEM CHANGED

INORGANIC chemicals produced by the mining and metal chemical divisions of United States Vanadium Corp. are now being marketed by Carbide and Carbon Chemicals Corp. Both companies are units of Union Carbide and Carbon Corp. United States Vanadium Corp. mines and processes domestic tungsten and vanadium ores, and produces the chemical derivatives in plants located at Henderson, Nev., and Niagara Falls, N. Y. The compounds made include ammonium paratungstate, tungstic acid, and tungstic oxide, tungsten carbide, and tungsten wire filaments. A new industrial product is phosphotungstic acid.

KODAK MAKES FIRST SALE OF CARBON ISOTOPE

FIRST commercial shipment of carbon 13, used by science as a tracer in biological research, was sent from Kodak Research Laboratories to the New York Memorial Hospital in December. Company officials said they believed the shipment marked the first sale of the isotope produced on a commercial basis. Valued at $200, the shipment consisted of one half gram of carbon 13 in the form of 12 grams of potassium cyanide with the carbon isotope in concentration above 20 percent. The company expects to facilitate the application of isotopes to research work by providing a variety of compounds with the isotopes inserted. It is expected that methanol will be one of the first of these compounds.

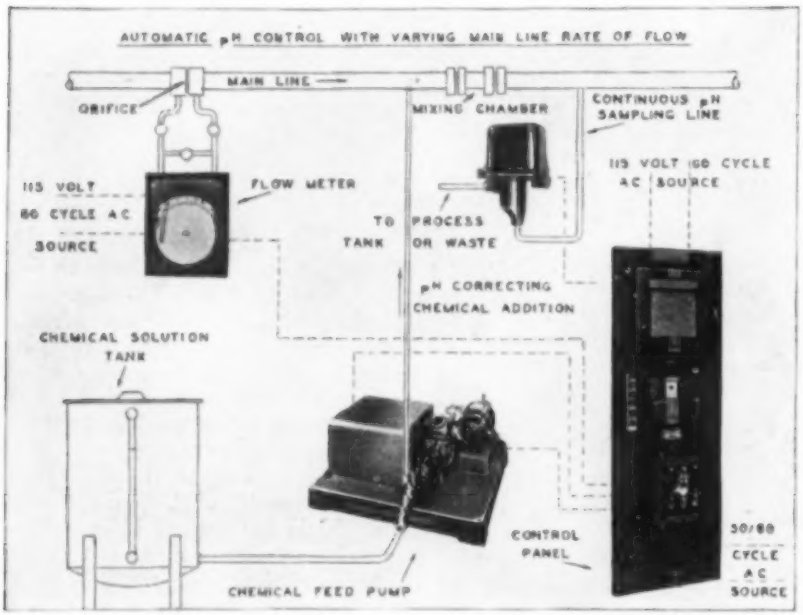
ASTM SYMPOSIUM ON PAINT TO FEATURE MEETING

DURING committee week of the American Society for Testing Materials, to be held in Philadelphia February 24-28, a symposium on paint at the Benjamin Franklin Hotel will feature the Spring Meeting. Another event will be the formal dedication of the society's headquarters building. The symposium on paint is being arranged by Technical Committee D-1 on paint, varnish, lacquer and related products, with the cooperation of the Philadelphia district of the society. Carlton H. Rose, National Lead Co., is chairman of the program committee. Formal dedication of the ASTM Headquarters building will be held on February 26, followed by a dinner at the Benjamin Franklin Hotel.

The society has recently approved a number of new and revised specifications and test methods. All of the new and revised tentatives will be included in the 1946 Book of ASTM Standards which is now being printed. New methods for determining sulphur in lubricating oils, tests for normal pentane and benzene insolubles in used lubricating oils, new specifications on clay facing tile, and tests for electrical

Automatic pH CONTROL

with Varying Main Line Rate of Flow



Milton Roy Pumps are controlled volume metering units, designed to meter and pump practically any liquid in volumes as low as 1 pint per hour to as high as 23 gallons per minute per pump side and against pressures as high as 20,000 lbs. per square inch. Because of the high degree of accuracy of volumetric measure made possible by the Milton Roy step valve design, these pumps have found many applications as components of automatic chemical feed systems.

In the system shown, for example, the capacity of the Milton Roy pump is automatically compensated for two variables — rate of flow and pH value. Pump motor speed is directly proportional to rate of main line flow and length of stroke of the pump is automatically adjusted by the pH controller. Thus the pH controller is only required to follow changes in chemical characteristics of the system, eliminating "hunting" and resulting in uniform pH correction.

The necessity for constant and automatic pH control is well recognized in many applications including water treatment, pharmaceutical manufacture, paper making and chemical processing.

The many automatic pH control systems designed by Milton Roy and now in successful operation demonstrate the suitability of Milton Roy equipment for these applications.

For further details on pH control equipment and other automatic Milton Roy Chemical Feed Systems for various applications write for Bulletin 468 and Technical Paper No. 54 "An Application of Electronics in Automatic Chemical Feed Systems."

MILTON Roy COMPANY

1322 E. MERMAID AVE., CHESTNUT HILL, PHILA. 18, PA.

insulating oils are among the test methods recently approved.

ACCL ELECTS OFFICERS AT ANNUAL MEETING

HOLDING its annual meeting in Chicago, the American Council of Commercial Laboratories elected the following officers for the 1947 term: president, H. L. Sherman of Skinner

CONVENTION CALENDER

Electrical Engineering Exposition, 71st Regiment Armory, New York, N. Y., January 27-31.

Society of Plastics Engineers, convention, Congress Hotel, and plastics exposition, Navy Pier, Chicago, Ill., January 28-February 2.

Chemical Market Research Association, winter meeting, Mount Royal Hotel, Montreal, Canada, February 6.

American Institute of Chemical Engineers, regional meeting, Brown Hotel, Louisville, Ky., February 16-19.

Technical Association of the Pulp and Paper Industry, annual meeting, Hotel Commodore, New York, N. Y., February 24-27.

American Society For Testing Materials, spring meeting, Benjamin Franklin Hotel, Philadelphia, Pa., February 24-28.

American Institute of Mining and Metallurgical Engineers, world conference on mineral resources, Waldorf-Astoria Hotel, New York, March 17-19.

American Society of Metals, western metal congress and exposition, Civic Auditorium, Oakland, Calif., March 22-27.

National Association of Corrosion Engineers annual meeting, Palmer House, Chicago, Ill., April 7-10.

Electrochemical Society, spring congress, Brown Hotel, Louisville, Ky., April 9-12.

American Chemical Society, 111th national meeting, Atlantic City, N. J., April 14-18.

Second National Plastics Exposition, Coliseum, Chicago, Ill., May 6-10.

Exposition of Chemical Industries, 21st exposition, Grand Central Palace, New York, N. Y., December 1-6.

USE NICLOY TUBES for longer service in ALKALINE conditions... ...LOW temperatures

WHEREVER tubing is needed that is highly resistant to severe alkaline corrosion or to low-temperature embrittlement, B&W Nicloy Seamless Tubes can always be depended upon to provide the right answer. Because they have been developed expressly to combat those tube hazards, Nicloy Seamless Tubes give long, satisfactory service life, and at moderate cost. Nicloy Tubes are much more resistant to attack by alkaline media—and have higher impact values at sub-zero temperatures—than do any carbon steels and many of the usual alloy steels.

Nicloy Tubes are especially suited to such applications as these: handling crude oils with substantial salt water and hydrogen sulphide content; handling liquefied gases or other low-temperature fluids in such processes as oil dewaxing; in black liquor recovery units and evaporators of pulp and paper mills; for caustic solution evaporation and alkaline-phenol solution work.

Nicloy Tubing can be readily rolled-in, expanded, or flared and can be produced to standard dimensional tolerances. Investigate the advantages of Nicloy Tubing and let the B&W Research Staff help you apply Nicloy's superior service characteristics to your tough tube jobs. Write for detailed B&W Tube Specifications.

MINIMUM TENSILE PROPERTIES	
Ultimate strength	80,000 psi
Yield Strength	50,000 psi
Elongation	20% in 2 in.

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Water-Tube Boilers, for Stationary Power Plants, for Marine Service • Water-Cooled Furnaces • Superheaters • Economizers • Air Heaters • Pulverized-Coal Equipment • Chain-Grate Stokers • Oil, Gas and Multi-fuel Burners • Refractories • Process Equipment.

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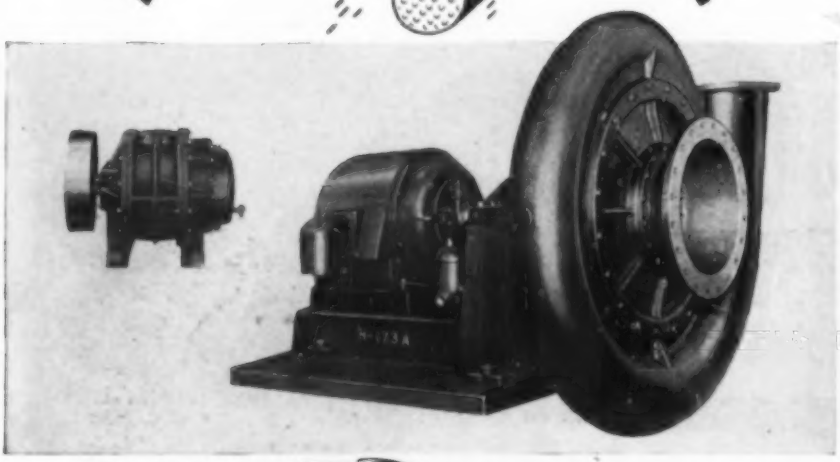
GENERAL OFFICES: BEAVER FALLS, PA.

PLANTS: ALLIANCE, OHIO AND BEAVER FALLS, PA.

A THIMBLE OF AIR..



OR A HURRICANE!

From our wide range of sizes and capacities, you can select a Roots-Connersville Blower to deliver nearly any quantity of air for practically any industrial process.

For instance, our Rotary Positive units are widely used in separate or built-in applications where a small amount of air is required. For large volumes, you have the choice between Rotary Positive and Centrifugal Blowers, depending upon your specific requirements.

R-C *dual-ability* to supply either Rotary or Centrifugal Blowers offers important advantages to users. Because we design and build both types, we can be completely unprejudiced in our recommendations. This *dual-ability* frequently results in substantial savings in first cost and operating and maintenance expense.

Whatever your requirements may be, whether to move air or gas, ask R-C *dual-ability* for the answer. You'll be sure of the right unit to suit your needs, for long years of profitable performance.

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701 Illinois Avenue, Connersville, Indiana

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ROTARY CENTRIFUGAL
BLOWER BUILDERS R-C SINCE 1854
BLOWERS · EXHAUSTERS · BOOSTERS · LIQUID AND VACUUM PUMPS · METERS · INERT GAS GENERATORS

• • ONE OF THE DRESSER INDUSTRIES • •

& Sherman, Inc.; vice president, F. B Porter of Southwestern Laboratories; treasurer, G. J. Esselen of Esselen Research Corp.; secretary, B. L. Oser, Food Research Laboratories, Inc.; and executive secretary, A. J. Nydick. R. R. Bowser, R. W. Truesdail, M. C. Wylie, and W. P. Putnam were elected to the executive committee.

Carroll L. Wilson

Appointed general manager of the United States Atomic Energy Commission on the eve of transfer to that agency of government atomic energy facilities

HEYDEN CONSTRUCTS ADDITION TO CHEMICAL PLANT

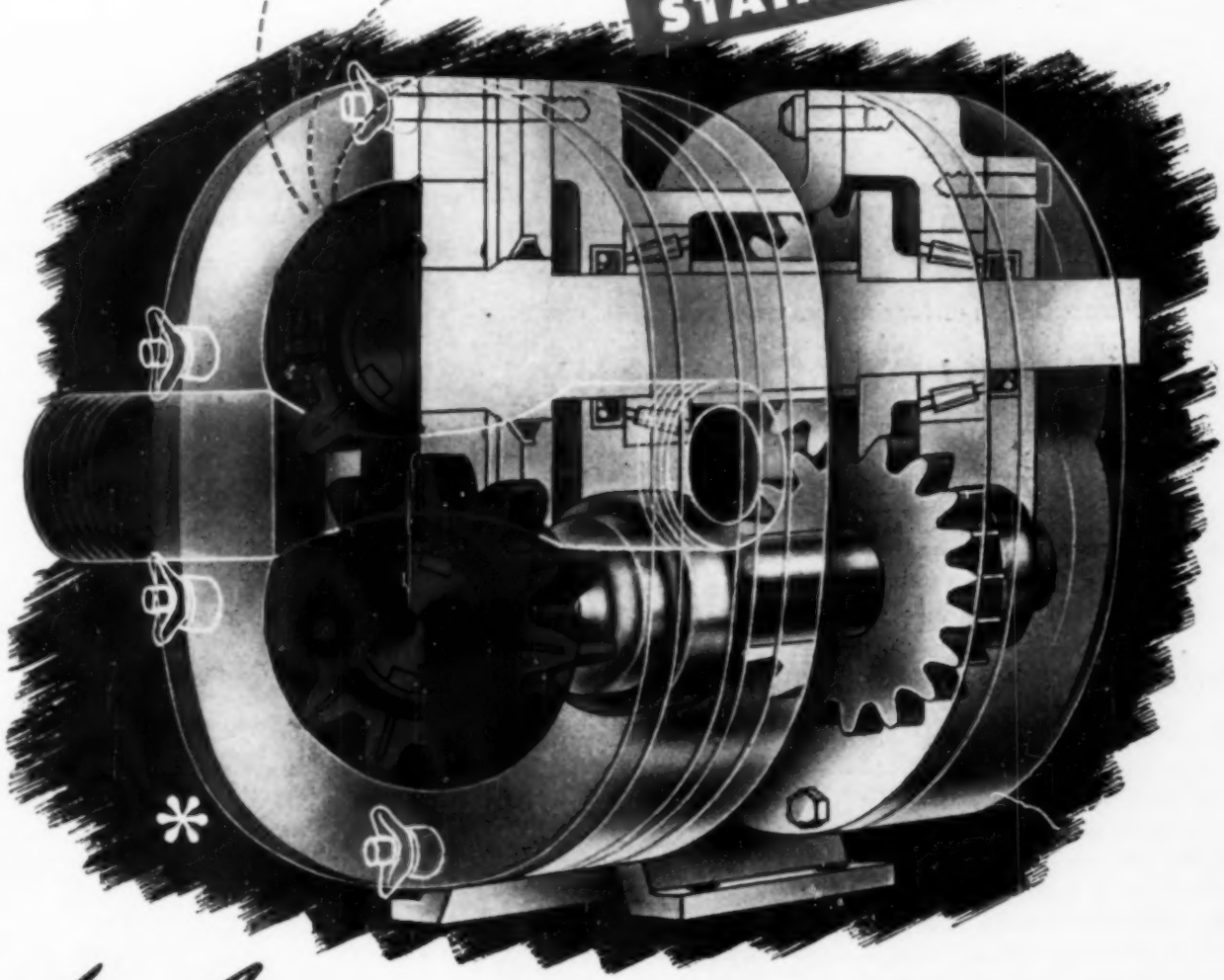
CONSTRUCTION of a $450,000 fine chemicals building as an addition to the Heyden Chemical Corp., Fords, N. J., plant has been announced by company officials. Of brick, steel and concrete construction, the new building will provide an additional 5,000 sq.ft. of floor space to be used in the production of organic chemicals. It will be two stories high except for the tower portion which will rise five stories to accommodate twin fractionating columns.

ION EXCHANGERS WILL BE USED BY SUGAR MILL

SO COMPLETELY satisfactory has been the ion exchange purification process in operations of the beet sugar pilot plant of Amalgamated Sugar Co. at Burley, Idaho, that full-scale plant production by ion exchange has been undertaken by the firm in a newly constructed factory at Twin Falls, Idaho. Cost of the new unit, which adjoins the firm's present beet sugar plant at Twin Falls, will be close to $500,000. The plant was reported to be in operation by the end of the 1946-47 sugar processing season. The process was developed by Amalgamated in cooperation with the Dorr Co., using synthetic resin ion exchangers pro-

FLOW-MASTER

THE NEWEST FINEST STAINLESS PUMP



for America's PROCESS INDUSTRIES

FLOW-MASTER "DeLuxe" for Heavy Duty. Automatic Wear Control Device Compensates for Normal Lateral Wear. Side Manual Adjustment Compensates for Normal Peripheral Wear.

500-4000 G. P. H. Against Head Pressures up to and Including 100 psi.

Catalog 25-A Contains Specifications, Engineering Data, Prices.

FLOW-MASTER Pumps—Homogenizers
Kom-Bi-Nators
Equipment For The Process Industries

MARCO COMPANY Inc. Wilmington 50, Del.

BETTER FILTER CLOTHS

FOR

Alkaline and Caustic Filtrations

Are Your Filter Cloths Costing Too Much?

Do they "gum-up" and give a poor filtrate?
Are they short lived?
Do you wish to lower your filtration costs and improve your filtrate?

for

"LONG LIFE" filter cloths

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Reg. U. S. Pat. Off.

For additional information and samples write:

METAKLOTH COMPANY

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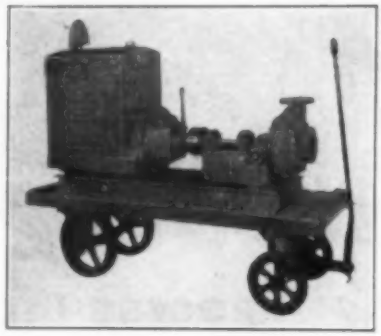
WM. L. BARRELL CO., Inc., 40 Worth Street, New York, N. Y., Sales Agents

A Portable LAWRENCE SLURRY PUMP Reclaiming Values From Waste

The mobility and economy of this gasoline-driven LAWRENCE PUMP are proving highly profitable in the plant of a large chemical manufacturer, in recovering metallic lead sludge from a waste-disposal area. Other LAWRENCE units, in a wide range of types and sizes, are used in large numbers in the many plants of this manufacturer, handling a variety of materials—fluid and semi-fluid—with satisfaction and profit . . . Why not avail yourself of our highly diversified experience in the chemical and process fields? Write for the Bulletins.



LAWRENCE PUMPS

SINCE 1862

LAWRENCE MACHINE & PUMP CORP.

369 Market Street, LAWRENCE, MASS.

LAWRENCE CENTRIFUGALS

FOR EVERY PUMPING DUTY

duced by Chemical Process Co., San Francisco. Four rubber-lined tanks have been installed to handle the cation exchanger and four similar cells for the anion material. Regeneration of the spent exchangers will be done with sulphuric acid and ammonia.

The new process would eliminate the use of coke, sulphur dioxide, and large quantities of milk of lime used in the purification of the sugar liquors and increase the yield of sugar per ton of beets. Possible byproducts would include an edible syrup, ammonium sulphate from spent regenerating chemicals, phosphates, betaine (used in pharmaceuticals), and monosodium glutamate which already has been recovered on a small scale.

In addition, a new-type "continuous diffusion" unit is being installed that will eliminate the present battery of 14 countercurrent diffusion cells and make possible diffusion of sugar from the shredded beets in a continuous process that one man can supervise, according to R. H. Cottrell, vice president of the organization. Developed by Silver Engineering Co. of Denver, the continuous diffusion cell is said also to reduce the "draw" from about 160 to 135, thus resulting in savings in water consumption and evaporation costs.

FOR NEW STANDARD OIL SALES SUBSIDIARY

ORGANIZATION of Enjay Co. Inc., to take over sale and distribution of all products handled by the chemical products department, Stanco Distributors, Inc., and Standard Alcohol Co. was completed this month. The following officers were elected in this new Standard Oil Co. of New Jersey subsidiary: H. W. Fisher, president; John A. Britton, Jr., and James G. Park, vice presidents; W. F. Quick, secretary; H. P. Schoeck, treasurer; G. M. Buckingham, assistant secretary; and L. R. Moore, assistant treasurer.

NAVY CONTINUES RESEARCH ON GUAYULE RUBBER

AIMED at developing sturdier, more productive rubber-yielding plants than can now be grown in the United States, a research grant of approximately $150,000 has been received by the newly-formed Stanford Research Institute, Palo Alto, Calif., from the Office of Naval Research. To last eight months, the project will be carried on at four government-owned laboratories at Salinas, Calif., at the university and on 340 acres of government land near Salinas which are planted with a wide variety of guayule strains.

Scientists engaged in the project will seek improved strains of hybrids

RESISTS CHEMICALS

Stainless steel is unaffected by corrosive media

This centrifugal machine, constructed entirely of stainless steel, recovers chemicals for re-use during the process of making Aralac protein-base textile fiber. Stainless steel is used here because it is not corroded by the action of the chemicals. Textile mills use stainless steel for much of their equipment because it is easily cleaned, is durable and rust-resistant, and because its smooth surface will not snag delicate fabrics. These same qualities make stainless steel highly desirable for equipment in many other industries as well.

If you are interested in the many uses of stainless and other alloy steels, ask to receive the monthly publication, ELECTROMET REVIEW.

If you need information on the production, properties, or fabrication of these steels, write our Technical Service Department. We do not make steel, but we do produce the ferro-alloys which are used in its manufacture, and our engineers have accumulated a fund of information on the use of stainless steel in many industries.

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Cylinder batteries — designed for small capacity, built-in systems. I.C.C. cylinders.
Liquid CO_2 units. Capacities 2000 lbs. to 200,000 lbs. Designed for your large capacity fire systems.
1000-lb. capacity A.S.M.E. containers. Designed for built-in systems using masses of high pressure CO_2.
YES — there is something new in Fire Protection Service ... it's MATHIESON

For the first time in the history of carbon dioxide (CO_2) fire-fighting equipment, one company offers both high and low pressure installations of manual and automatic design. Survey made on request. *THE MATHIESON ALKALI WORKS (INC.) 60 East 42nd Street, New York 17, N. Y.*

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Liquid Chlorine . . . Chlorine Dioxide . . . Ammonia, Anhydrous & Aqua . . . HTH Products . . . Fused Alkali Products . . . Synthetic Salt Cake . . . Bicarbonate of Soda . . . Sodium Chlorite Products . . . Sodium Methylate

Mathieson Fire Extinguishing Equipment for every purpose:

- *Existing Plant Facilities*
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- *New Plants*
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of guayle and other rubber-producing plants which will grow more rapidly and be at home even in poor soil. An effort will also be made to develop a more efficient and economical process of separating rubber from other plant materials.

BUCKNELL CHANGES COURSE IN CHEMICAL ENGINEERING

BUCKNELL University's new undergraduate course in chemical engineering is designed to give flexibility in training students for any of the following types of chemical engineering work: process research and development; engineering design including process equipment and plant design; production management; and technical sales. Among graduate courses beginning in February are: process development, process equipment design, industrial process control, metallurgy engineering, and series of advanced courses in unit operations.

MERCK RESEARCH FUND SET UP AT LEHIGH

AT Lehigh University Dr. Darrel E. Mack, associate professor of chemical engineering, will supervise a new research project in the William H. Chandler Chemistry Laboratory, Dr. Harvey A. Neville, director of the Institute of Research, announced recently. Sponsored by Merck & Co., Rahway, N. J., under a grant to be called the Merck Agitation Research Fund, the latest research program to be undertaken at Lehigh will be devoted to a study of gas, liquid, solid and heat transfer processes to point the way to practical methods of agitator design. Assisting Dr. Mack is Richard A. Marriner, Merck Research Fellow.

AMERICAN SECTION SCI AND NY SECTION ACS MEET

A JOINT meeting of the New York Section of the American Chemical Society and the American Section of the Society of Chemical Industry is scheduled for February 7. Dr. Harry McClure of Carbide and Carbon Chemical Corp. will speak on Recent Developments in Aliphatic Industrial Chemistry. Dr. Raymond E. Kirk is chairman of the New York Section of the ACS and Sidney D. Kirkpatrick is chairman of the American Section of the SCI.

The New York section is holding an all day symposium on recent developments at Hunter College on January 25. Prof. Harold Cassidy, Yale, will speak on chromatography; Prof. T. I. Taylor, Columbia, will discuss the application of the mass spectro-

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Type FS Two-Gang Tandem Vaportight Condulet with Switch and Plug Receptacle

Type MSR Two-Gang Watertight Marine Interlocked Switch and Receptacle Condulet

Type DXE Condulet with Two Switches

Type GSB Three-Gang Vaportight Condulet with Switches

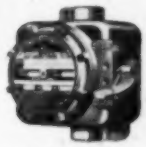
Type ZT Safety Switch Condulet

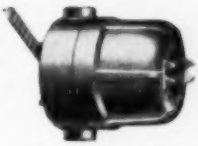
Type WMK Raintight Safety Switch Condulet

Type WMKS Raintight Safety Switch and Interlocking Receptacle Condulet

Type EGP Explosion-Proof Mercury Switch Condulet for Panel Mounting

Type EGP Explosion-Proof Push Button Stations and Pilot Light Condulet for Panel Mounting


Type GUSC Explosion-Proof Line Starter Condulet


Type EMS Explosion-Proof Mercury Limit Switch Condulet

Type FLDC Explosion-Proof Secondary Breaker Condulet

Type FSQC Explosion-Proof Interlocked Receptacle and Switch Condulet

Type EFS Explosion-Proof Push Button Switch Condulet

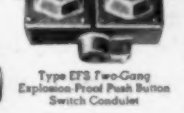
Type FSPC Explosion-Proof Switch Condulet with Threaded Cover

Type FLS Explosion-Proof Switch Condulet

Type GUB Explosion-Proof Motor Starting Switch Condulet

Type HRC Explosion-Proof Mercury Switch Thermostat Condulet

Type EFD Explosion-Proof Motor Starting Switch Condulet


Type EFS Two-Gang Explosion-Proof Push Button Switch Condulet

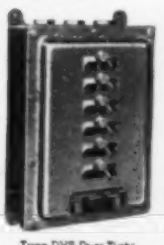
Type HR Explosion-Proof Thermostat Condulet

Type EFSC Explosion-Proof Control Station Condulet

Type OFC Explosion-Proof Push Button Station Condulet

Type EPC Explosion-Proof Circuit Breaker Condulet

Type EFSC Explosion-Proof Triple Switch Condulet


Type EFSC Two-Gang Explosion-Proof Push Button Stations and Pilot Light Condulet

Type DVS Dust-Tight and Vaportight Circuit Breaker Condulet

Type DVS Dust Tight and Vaportight Circuit Breaker Condulet

Type EFS Explosion-Proof Switch Condulet

Type GRF Condulet with Switch

Type FHRC Mercury Switch Thermostat Condulet

Type YSW Vaportight and Weatherproof Circuit Breaker Condulet

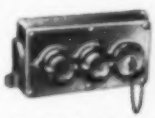
Type FST Threadless Condulet with Switch

Type FA Four-Gang Watertight Safety Switch Condulet

Type FS Condulet with Pilot Light Switch and Plug Receptacle

Type FS Two-Gang Watertight Marine Switch Condulet

Type FSC Vaportight Push Button Station Condulet


Type MSR Three-Gang Watertight Marine Switch and Receptacle Condulet

Type FS Vaportight Push Button Station Condulet

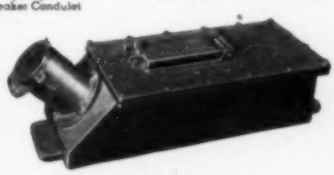
Type FG Door Switch Condulet

Type FDC Vaportight Secondary Breaker Condulet

Type FS Vaportight Condulet with Three Switches

Type FS Five-Gang Condulet with Switches and Plug Receptacles

Type FS Three-Gang Condulet with Switches


Type WSR Weatherproof Circuit Breaker and Receptacle Condulet

Type FGCH Explosion-Proof Switch Condulet for Gasoline Bulk Stations

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Complete listings of each type are in Condulet Catalog No. 2500 or in supplementary bulletins.

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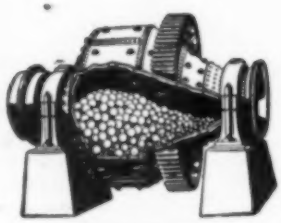
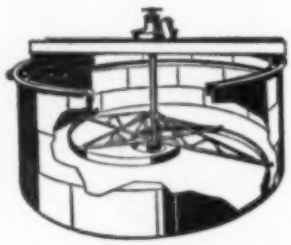
The completeness of the Hardinge line is one of its many outstanding features. Five typical units are shown here. To the prospective purchaser, buying new equipment and replacing old, this means that for practically every process or operation there is a Hardinge unit engineered to meet the need. Buying from a single source—from a manufacturer whose products stand up under the hardest jobs and most difficult conditions—has definite advantages and demonstrable economies.



HARDINGE MILL



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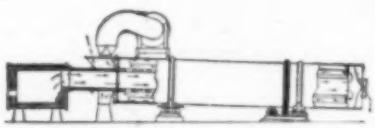
Extremely low maintenance costs are another advantage the Hardinge line offers. Sturdy construction, manufacturing processes, and practical engineering by men who know the jobs the equipment has to do . . . these combine to make maintenance expense a minimum.



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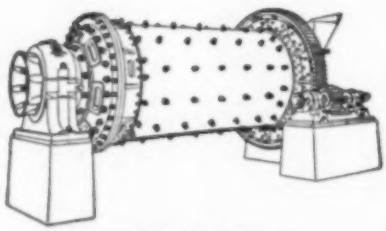
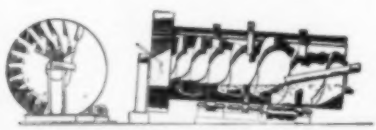
Surveys

Let trained men from the nearest Hardinge branch office assist you to determine your equipment needs. Nominal surveys are made without charge, and you can depend on the recommendations made. Consult the list of branch office addresses below.



HARDINGE ROD MILL



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graph; Prof. G. Glockler, University of Iowa, will cover modern concepts of molecules; Dr. M. H. Trytten, director of Office of Scientific Personnel, will discuss national security and the training of scientists; Prof. H. B. Hass, Purdue University, will talk on nitroparaffins; and Prof. Arthur Tobolsky, Princeton, will speak on chemical and physical properties of synthetic and natural rubber.

Dr. Monroe E. Spaght, vice president of Shell Development Co., will address the American Section of the SCI, Thursday, February 20, at 8 p.m. He will speak on "Future Research in Hydrocarbons" in the executive club rooms of the International Business Machines Corp. Bldg., 590 Madison Ave., New York.

NEW TRADE PRACTICE RULES FOR SALE OF DYES

CHARACTERISTICS for home-use dyestuffs will be more accurately defined for packaging and advertising under new trade practice rules being drafted by Federal Trade Commission. Such words as "fast," "sunfast" and "fadeless" will have to have a definite performance equivalent, or misbranding will be charged against distributors. Producers in making guarantees to packagers will be interested in reading the new rules which are expected for release before very long.

PENNSALT SETS UP LABELING AND PACKAGING DIVISION

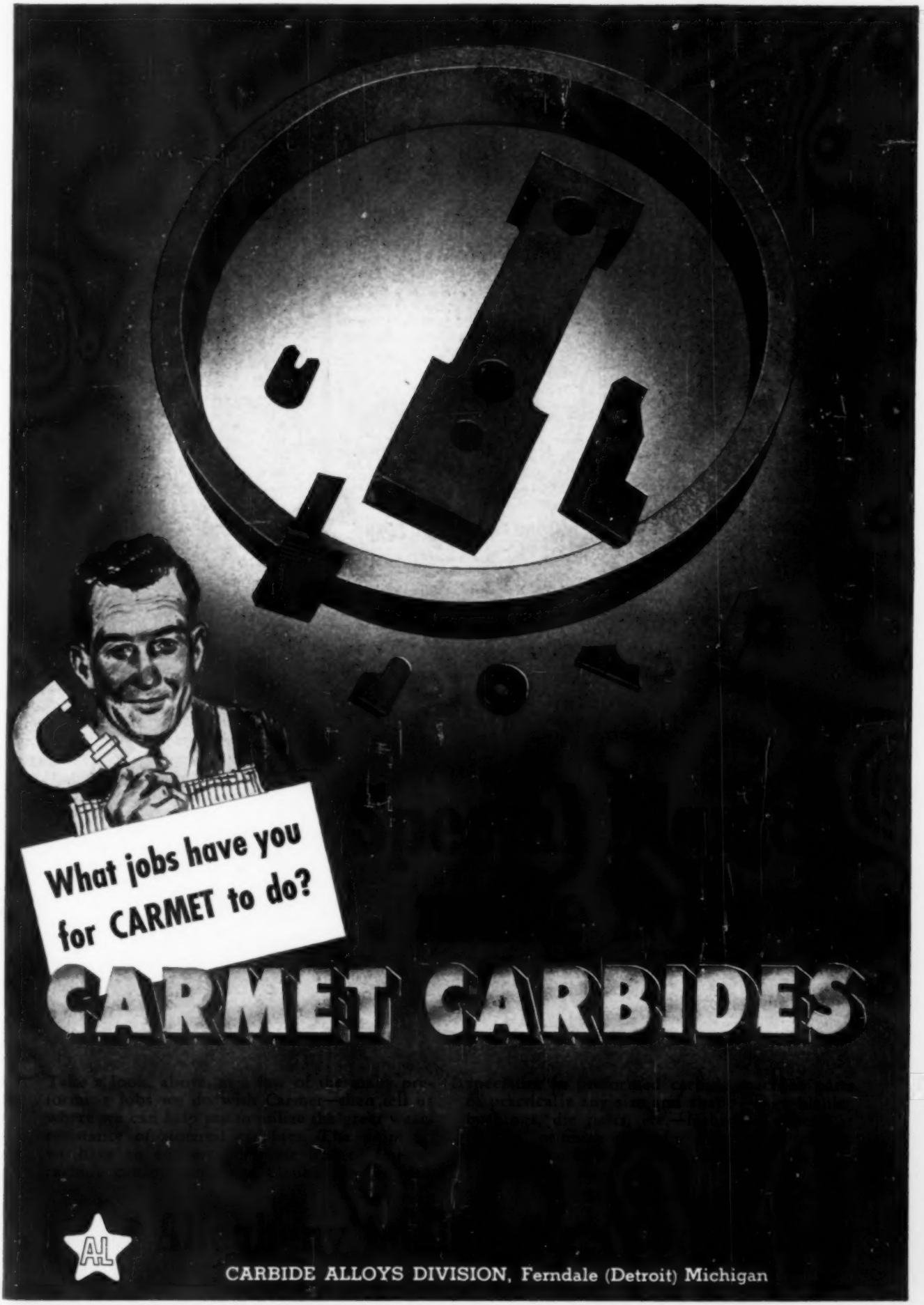
EXPANDING its activities in the field of chemical specialities and chemical products for consumers, the Pennsylvania Salt Mfg. Co. has established a new packaging and labeling division, which began operations in December. George W. Benbury, packaging engineer, has been appointed manager of the new division. Joseph A. Noone has been named technical advisor on labels and registration.

PFIZER TAKES TITLE TO GROTON SHIP YARD

CHAS. PFIZER & Co., Inc., Brooklyn, New York, has acquired the Victory Yard property at Groton, Conn. from the War Assets Administration. The property was operated during the war by the Electric Boat Co. The new owner intends to develop the site as a chemical plant. This will add to Pfizer's current production activities at the Brooklyn plant.

ALUMINUM COMPANY DROPS ALORCO TRADE NAME

ALUMINA and fluoride products of Aluminum Ore Co., an Alcoa subsidiary, are now marketed under the Alcoatrademark and trade name. The Alorco trade name and trademark, which for years have identified prod-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ucts of Aluminum Ore Co., has been discontinued, and all merchandising is conducted in the name of Aluminum Co. of America, Chemicals Division. Aluminum Ore Co. will continue the actual manufacture of the products. The principal alumina products which will be sold under the Alcoa label include: activated aluminas, tabular aluminas, hydrated aluminas, and calcined aluminas. The fluorides includes sodium fluoride, sodium acid fluoride, and cryolite.

REICHHOLD MAKES NEW RESIN EXPANSION IN NORTHWEST

CONSTRUCTED in 1942 to produce charcoal for the Chemical Warfare Service and subsequently sold by WAA, the new Seattle, Wash., resins plant of Reichhold Chemicals, Inc., is beginning preliminary operations and will be one of the largest plants of its kind on the Pacific Coast when completed, according to company officials. Acquisition of the property gave the firm a complete chemical plant, laboratories, offices and a 16-acre site on the Duwamish River with access to ocean shipping, and it is rapidly being converted for production of synthetic resins. Investment in machinery and other facilities has been estimated at close to $500,000. Low water and electric rates were credited with being highly important in clinching the deal to locate the plant in the Northwest.

First manufacturing units will produce phenolic, urea and melamine resins for Northwest plywood mills. Immediate production also is planned for "wet strength" and coating resins for the paper industry and impregnating resins used in the manufacture of plastic-faced plywood. Resins used in the formulation of surface coating materials also will be made. The first year's resin production is expected to be in excess of 25,000,000 lb., with a minimum capacity of 2,000,000 lb. monthly.

CARBIDE AND CARBON BUILDS ADDITION TO RESIN PLANT

SOON Carbide and Carbon Chemicals Corp. will begin construction of units for the manufacture of Vinylite resins as an addition to its plant at Texas City, Tex. These new facilities will be erected on land owned by the company west of its present location between LaMarque and Texas City, and will form a part of a general building program involving about $15,000,000. The project is an extension of a plant expansion program, begun in 1945, which includes the construction of a unit for the manufacture of butyl alcohol, extensions designed to increase production of industrial

•Calcium Acetate, Purified

This B&A Purity Product . . . assays 99% min. $Ca(C_2H_3O_2)_2 \cdot H_2O$. It is a white, uniformly-sized powder offering many advantages over ordinary acetate of lime for a wide range of applications: in liming rosins for varnish manufacture; in preparation of metal resinates and metallic soaps for many industrial uses; in the manufacture of pharmaceuticals, synthetic resins, etc.

FINE CHEMICALS . . .

•Cuprous Chloride, Tech.

Uniform, grayish-brown powder assaying in excess of 90% CuCl. Here is another B&A Quality Chemical markedly superior to the usual commercial and technical grade products. Has a wide range of applications: in manufacture of paint pigments, colors for fireworks, and vat dyestuffs; and as a mordant for fixing lake colors, etc.

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•Aluminum Nitrate, Crystal

Colorless 9-water crystal available in two grades—Reagent and Purified. The extremely high quality and very low limits of impurities of the Reagent grade make it particularly adaptable to use as a source of aluminum oxide in manufacture of fluorescent lamps, incandescent light bulbs, and radio tubes. The Purified grade offers a quality suitable for less exacting uses: as a mordant in textile printing, and as a raw material for manufacture of aluminum oxide and silica-alumina catalysts for the Petroleum Industry.

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From Coast to Coast—wherever *quality chemicals* are required *in quantity* for manufacturing processes of the day—B&A Fine Chemicals are the first choice of Industry. That is because they are reliable products of consistently high quality and uniformity . . . products made with all the skill and science B&A has gained in 65 years of "Setting the Pace in Chemical Purity."

Above are but three of the Fine Chemicals commercially available today from the Baker & Adamson Division of General Chemical Company. Scores more await your investigation, too. To learn more about those that meet your needs, write or 'phone nearest B&A Office below.

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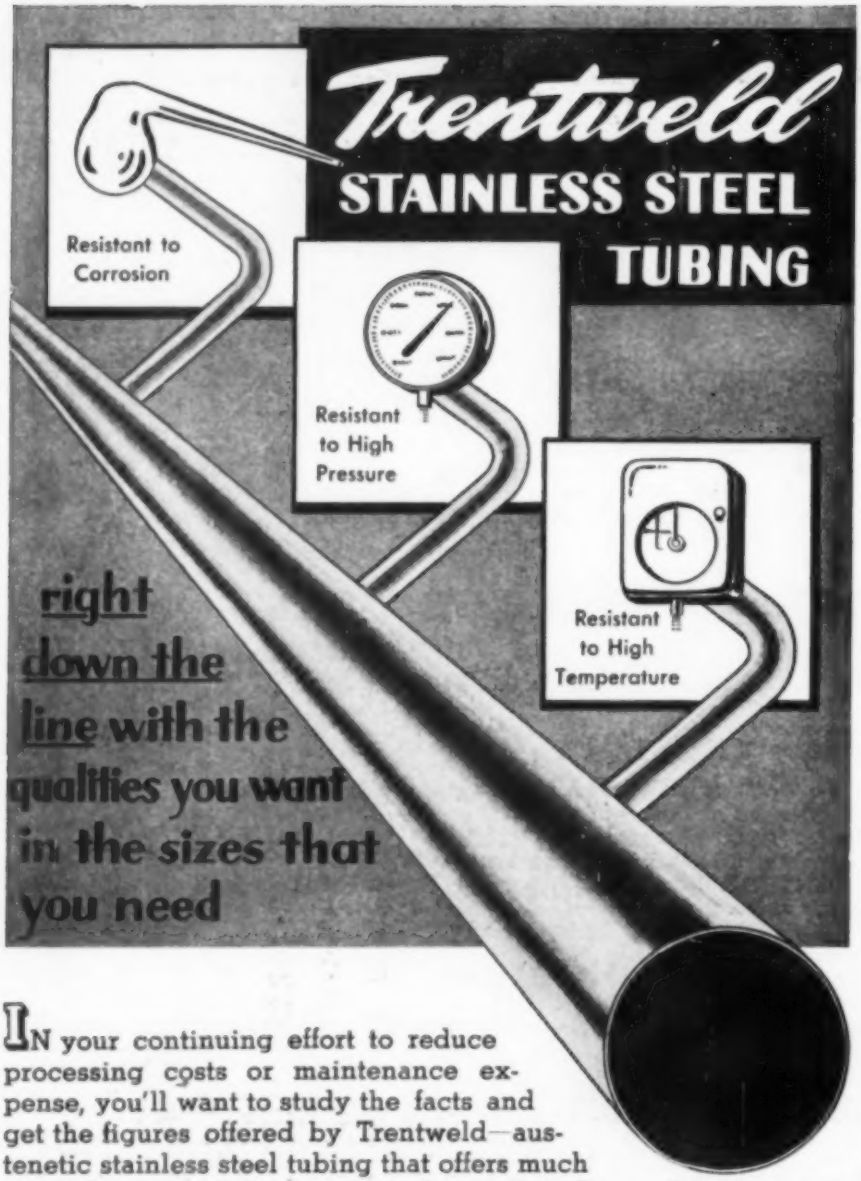
SETTING THE PACE IN CHEMICAL PURITY SINCE 1882

* Complete stocks carried here.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organic solvents and anti-freeze compounds, and additions to the shop, laboratory and service buildings. In addition, the company expects to construct a unit for the production of ethyleneamines.

NEW CARBON BLACK PROCESS IS USED BY RUBBER UNIT

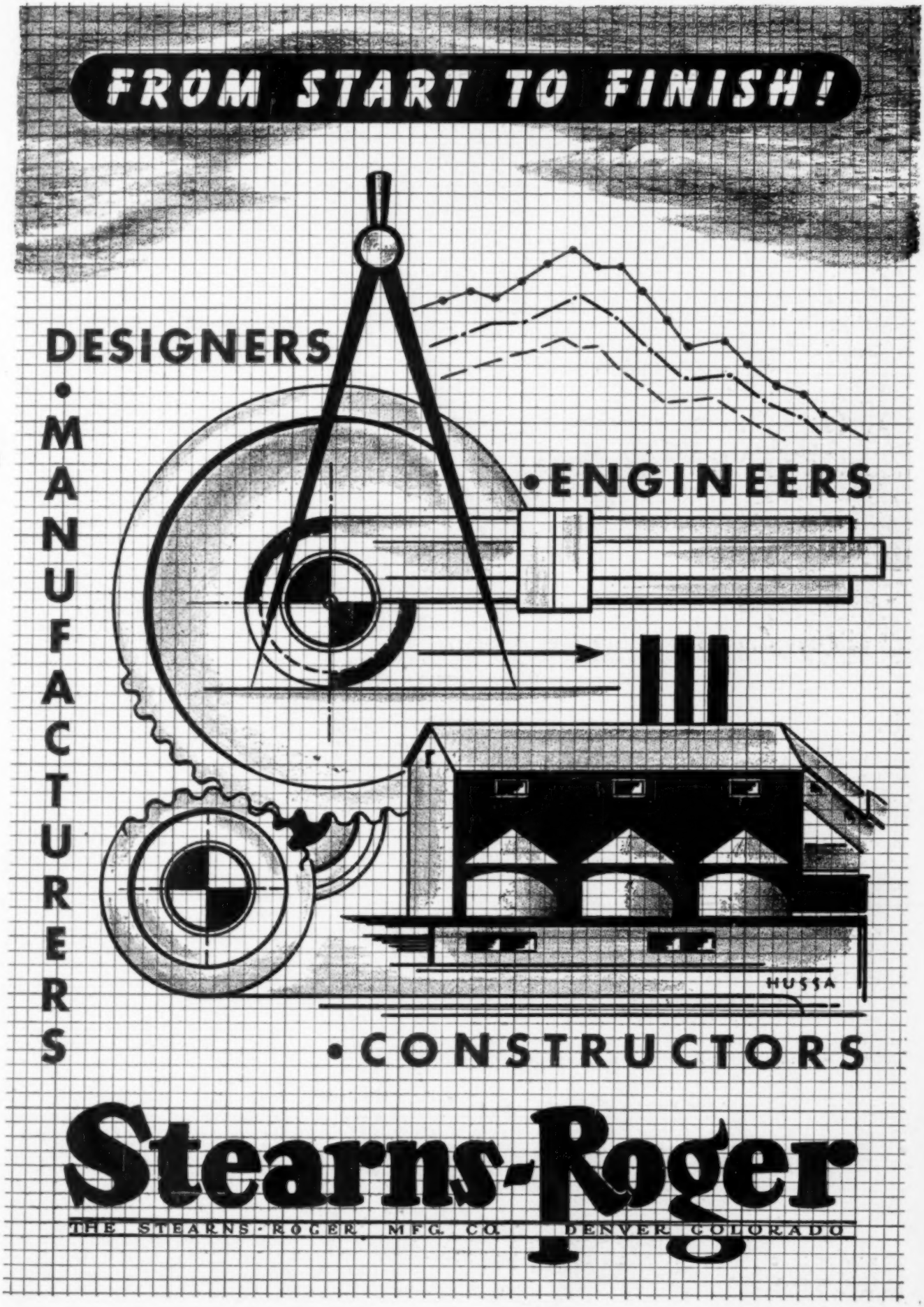
NEW FACILITIES are now being installed at the Torrance, Calif., plant of U. S. Rubber Co. (RFC) that will improve the wearing quality and lower the cost of synthetic rubber tires, according to a recent announcement. The installation, first of its kind on the Coast and second in the United States, will make it possible to blend carbon black directly into rubber latex just prior to coagulation rather than resort to the present laborious milling step in the tire plant. With the aid of a wetting agent, the carbon black is slurried with water in a 30,000 gal. holding tank, then added to the latex which is processed in the usual manner.

Since this process gives a more even dispersion of the carbon black, its use will add 10-15 percent to the wear-life of tire tread stock, according to one company representative. The new facilities will be capable of treating some 2-2.5 million pounds of rubber monthly; this entire output will be made available to Pacific Coast fabricators. The Los Angeles tire plant of U. S. Rubber Co. is now capable of producing twice its prewar tonnage of tires, or close to 11,000-12,000 units daily.

TACOMA ALUMINUM PLANT SOLD TO KAISER

SALE of the Olin aluminum reduction plant, Tacoma, Wash., to Permanente Metals Corp., Oakland, Calif., a Henry Kaiser subsidiary, for $3,000,000 has been approved by WAA. Operated during the war by Olin Industries, Inc., the plant, which originally cost $6,500,000, has two pot lines and a rated capacity of 41,500,000 lb. of aluminum ingots yearly. The company plans to spend another $1,000,000 converting the plant for production of aluminum for civilian uses.

Meanwhile, the Mead reduction plant in Washington, which has a rated capacity of 192,000,000 lb. of aluminum ingots per year, and which was leased by Permanente Metals Corp. from WAA earlier in the year, is operating four of its six pot lines. The combined capacities of the two reduction plants will produce approximately the ingot requirements for capacity production at the Kaiser rolling mill at Trentwood, Wash. The firm's alumina plant at Baton Rouge, La., with a design capacity of 500,000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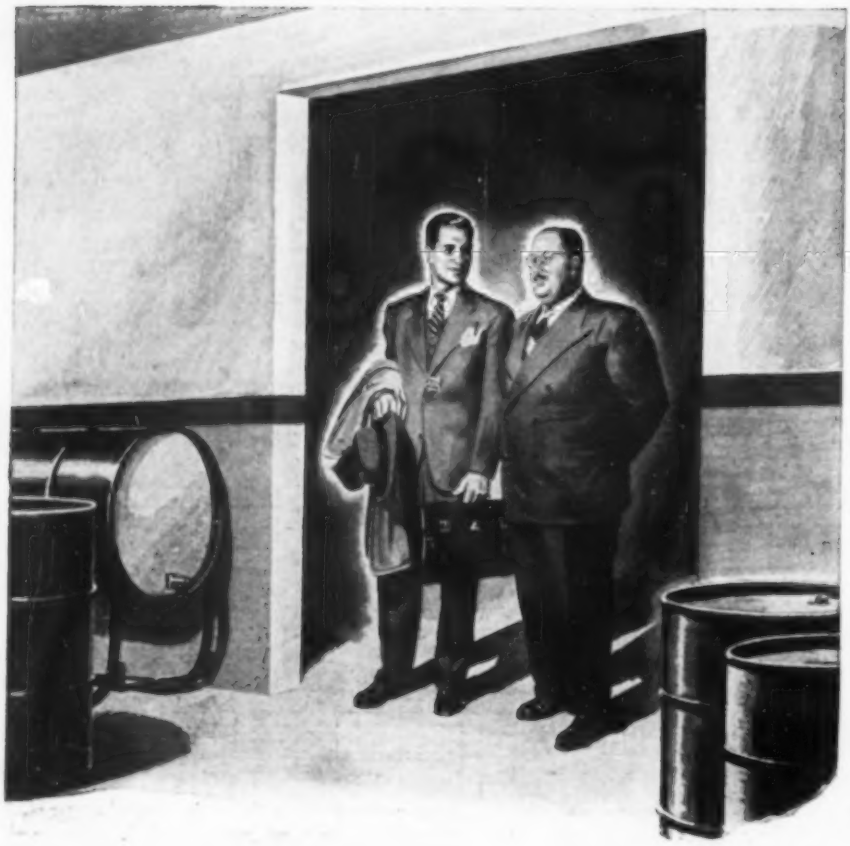

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Wherever you have a fire hazard involving storage of flammable liquids—paints, solvents, oils . . .

You'll find it worthwhile to talk it over with a Kidde representative!

He's an old hand at fire protection problems. He can study your specific hazard, and suggest the type of extinguishing equipment best suited to your needs—built-in systems, wheeled units, portables.

All types of *Kidde* carbon dioxide extinguishing equipment, of course, offer the same basic advantages. Fast, sure action against fires in flammable liquids and electrical apparatus. No corrosion of metals, no contamination or dilution of liquids. No after-fire mess. Carbon dioxide is deadly to fire—harmless to everything else!

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FIRE PROTECTION HEADQUARTERS

tons yearly, started operations in December and is able to supply Permanente's current alumina requirements. Under the present system of allocating soda ash, the Baton Rouge unit will be able to supply 85 percent of Kaiser's ultimate aluminum requirements.

SOUTHERN PAPERBOARD MILL UNDER CONSTRUCTION

CONSTRUCTION of the new $11,000,000 mill of the Southern Paperboard Corp. was started in November with President Ernest Rossiter setting into motion the driving of the first pile on the 183-acre tract at Port Wentworth, seven miles northwest of Savannah on the Savannah River. The mill is designed to produce an average of 450 tons of liner board and similar products. However, the supporting facilities for the manufacture of pulp, power, and the recovery of chemicals is provided for in such a manner that the full capacity of the 236-in. paper machine to be installed can be ultimately obtained. The mill is designed so that different classes of wood may be treated entirely separately throughout and combined into blended furnishes, as desired.

Provisions have been made for later addition of a bleach plant, a second paper machine, and a converting plant for the manufacture of corrugated boxes.

VICTOR CHEMICAL ELECTS NEW OFFICERS

AT THE December meeting of the board of directors, the following officers of Victor Chemical Works were elected to take office on January 1: August Kochs, chairman of the board; Walter B. Brown, president; Rothe Weigel, executive vice president; and Otto H. Rasche, vice president in charge of sales.

KOPPERS WILL BUILD PLANT TO MAKE POLYSTYRENE

IT WILL take about a year to build and place in operation, the new polystyrene plant Koppers Co., Inc., has authorized its engineering and construction division to design and build at Kobuta, Pa. This plant will have an annual capacity of 15 million pounds, according to Dan M. Rugg, vice president and general manager of the chemical division. The plant will be adjacent to the styrene and phthalic anhydride plants now owned and operated by Koppers at Kobuta. The firm is producing polystyrene commercially on a small scale at its Kobuta chemical plant, and expects to make first shipments soon. Small commercial produc-

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In addition to the above forms, JESSOP supplies stainless steel in billets, forgings, circles, tube rounds, and special shapes.

JESSOP Stainless Steels are furnished in ALL standard AISI types. For the processing industries, Jessop specializes in the following types, which are not generally available:

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Type 309S	Type 316Cb	Type 330
Jessop 316 Special	Jessop 317 Special	

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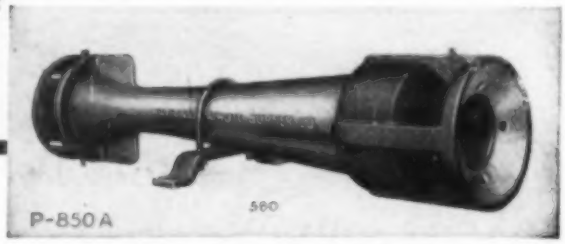
"AIROCOOL" GAS BURNERS



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"Airocool" Gas Burners, of venturi type, assure: maximum percentage of primary air-inspirated; close adjustment of primary air-gas ratio; a non-luminous flame with highest heat liberation throughout its capacity range; and easy removal and replacement of gas orifice.

Its patented "Airocool" Nozzle directs the separate ignitor flames against the main volume of the mixture to insure stable ignition; prevented overheating and burning of the castings; and allows greater turndown without flame burnback.

For full information about "Airocool" Gas Burners and "Airocool" long life Nozzle, write for supplement #3 to bulletin 55.

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tion from these facilities will continue until the large plant is in operation.

NAVAL STORES REGULATIONS SLIGHTLY AMENDED

EMPLOYEES at some of the large central naval stores distillation plants can now be deputized to provide for licensed inspection of rosin and turpentine by amendment of the regulations for the enforcement of the Naval Stores Act of 1923. This will permit licensed inspection at the convenience of the management of these plants without calling on "outside" federal inspectors.

READERS' VIEWS and COMMENTS

NATIONAL ENGINEERING SOCIETY

To the Editor of Chemical Engineering:

Sir:—Engineering magazines and technical journals have devoted much space to the subject of the organization of an over-all engineering society. There have been made so many surveys and polls; there have been published so many reports, articles and editorials; there has been so much discussion at national, state and local levels—so much of all of this—that the poor average engineer is somewhat at a loss to comprehend the lack of progress.

It is my opinion that the simplest plan with which a real beginning could be made, would capture the fancy of the entire engineering profession so readily that success likely could be achieved. I have a simple plan and I think it is a workable one. It is my desire to offer this plan without comment except to point out several of its more important features.

In order to qualify properly the profession with the public, legal qualification of engineers by registration under state laws appears to be the only sound basis, regardless of the fact that there is some opposition stemming from within the profession.

The plan provides for the setting up of a Professional Grade of membership in each of the recognized engineer groups. This is the principal device through which it is believed that success can be achieved.

The plan provides for the individual option of each member of a founder society or other recognized engineer group to join or not to join a National Society.

I am attaching copies of what I have chosen to call, "A Plan for the Creation of a Comprehensive National Engineering Society." I propose to distribute additional copies generally to

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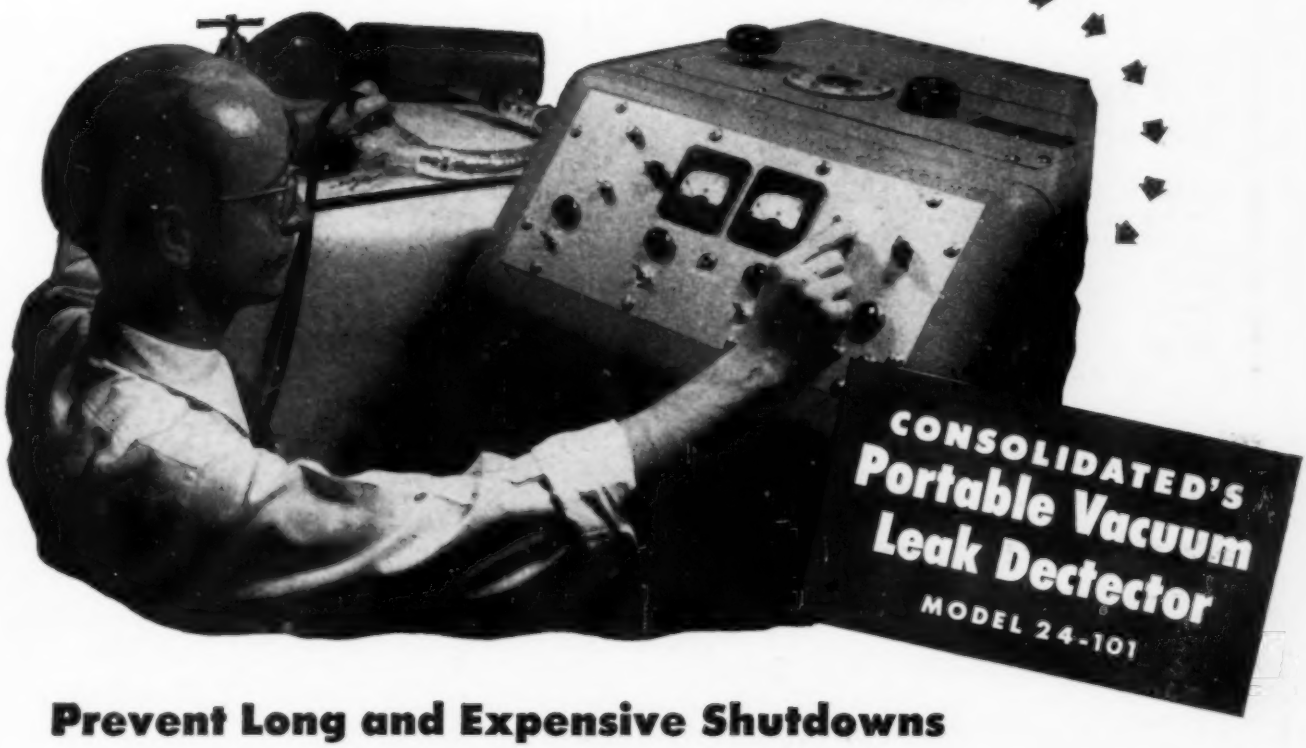
as small as $\frac{1}{100,000,000}$ cc. per second



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Wherever there is a vacuum or pressure system operating inefficiently due to leakage, or wherever production equipment is being tested for leakage, a Consolidated Leak Detector should be on the job. Simple to operate, it is extremely accurate and fast in detecting and measuring leaks. It is a new tool that will save you much time and many dollars lost due to costly leaks.

The operation of the Consolidated Leak Detector is based on the Mass Spectrometer principle. Essentially, it consists of an ionization chamber set up to measure helium as it passes through the system. By introducing non-contaminating helium into suspected areas of leakage, the smallest leak will be indicated on the Leak Rate Meter and set the Audio Alarm into operation. One man can operate this instrument.

Many adaptations for specific leakage tests can be made by your engineers or ours. Write Dept. 104 today for additional information.

- **PORTABLE**
  22" x 25" x 43", wt. 300 lbs., mounted on rubber-tired ball-bearing casters.
- **SENSITIVE**
  Selection of six ranges of Leak-Rate Meter readings.
- **ACCURATE**
  Measures leakage rate to .00000001 cc. per second.
- **SIMPLE TO OPERATE**
  Audible and visible alarm for one-man operation.
- **STANDARD POWER**
  115 V. 60 cycles A. C., operates wherever ordinary lighting circuit is available.
- **ECONOMICAL**
  Uses only 850 watts and negligible amounts of helium and liquid air. No water is needed.
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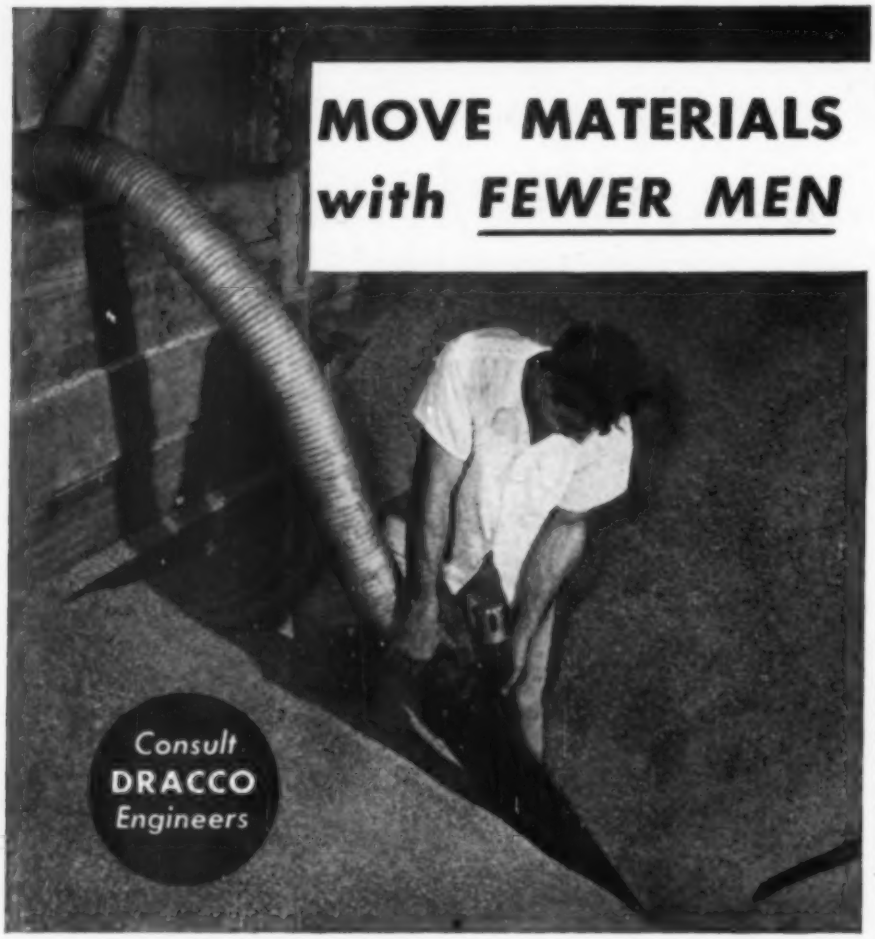

This illustration shows a typical application of DRACCO Pneumatic Conveyors, with ONE man and the DRACCO Pneumatic Conveyor doing the work of SEVERAL men. In many industries, DRACCO is handling chemicals, grains and granular materials more efficiently, and at less cost . . . with fewer man hours. Why not let DRACCO Engineers check your present material handling methods. They have had over 30 years of experience in material handling.

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the technical press and to the various engineer groups.

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A Plan for the Creation of a Comprehensive National Engineering Society
Basic Organizational Outline

In the following, "Society" shall be interpreted as meaning any engineering association, institute, or society, other than the National Society; "National Society," The National Society of Professional Engineers, or such other name as may be adopted.

1. Professional Membership in any Society shall be restricted to Registered Professional Engineers, licensed under the laws of the several states.

2. An individual may maintain Professional Membership in but one Society, although memberships of other classifications may be maintained in more than one Society.

3. All Professional Members of the several Societies automatically shall become members of the National Society, and of the State Society of Professional Engineers in the state in which official residence or place of business is maintained, option remaining with the Professional Member where residence and business are not in the same state.

4. Dues for each Professional Member of the several Societies shall be collected by the Society in which Professional Membership is maintained, and forwarded to the National Society. The amount of such dues shall be fixed by the National Society, and shall be uniform within and between the several Societies. National Society dues shall be paid concurrently with annual Society dues. Where Professional Membership is maintained in a Society other than a State Society of Professional Engineers, a fixed amount of the dues collected from each Professional Member shall be paid by the National Society to the State Society of Professional Engineers existent in the state in which the Professional Member maintains official residence or place of business, option remaining with the Professional Member where residence and business are not in the same state. The fixed amount shall be by agreement between the several State Societies of Professional Engineers and the National Society, and shall be uniform.

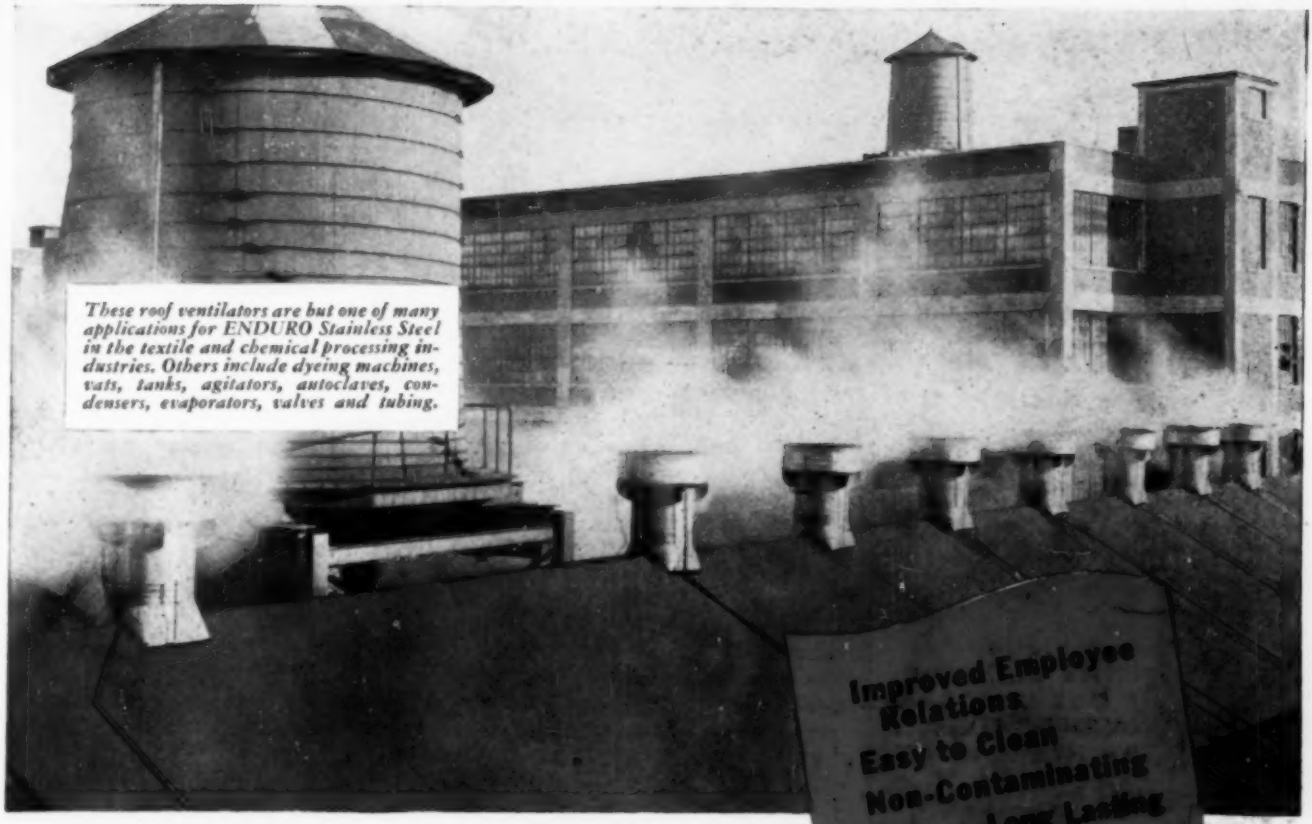
5. All executive officers of Societies at national, state and local levels, shall be Professional Members.

6. The Constitution and the By Laws of the National Society shall be based upon unqualified democratic principles; control of the National Society shall be vested in the Professional Members of the several Societies, such Professional Members having individual or collective voting power equally prorated throughout the Professional Membership.

7. The National Society's existence and the conduct of its affairs primarily shall be in the interests of the Engineering Profession and the Public.

The changes necessary to affect this organization are the enactment of amendments to the Constitutions and the By Laws of the several Societies to provide for Professional Member classifications, for the collection of dues to the National Society, and for the election of their executive officers from among their Professional Members.

The success of any organized group of individuals is dependent upon the individuals themselves and the energy and cooperation lent by them to their organization—no organization is more successful than the collective successes of the individuals who themselves are the organization.



These roof ventilators are but one of many applications for ENDURO Stainless Steel in the textile and chemical processing industries. Others include dyeing machines, vats, tanks, agitators, autoclaves, condensers, evaporators, valves and tubing.

Enduro Pays in many ways

Among the major reasons why Republic ENDURO Stainless Steel is a "natural" material for chemical and textile processing applications is its inherently high resistance to rust and corrosion.

Consider the case of these textile dyeshop roof ventilators. When made of ordinary steel, the high cost of replacing corroded ventilators every six months was dwarfed by the costly annoyance of rusty drippings which contaminated dyes and damaged materials.

After they were made of long-lasting ENDURO, however, these ventilators ceased being a source of constant maintenance and replacement expense. Rusty drippings were ended.

Perhaps you, too, have applications in which this and other ENDURO advantages effectively can reduce operating overhead. Talk to your equipment manufacturer, or write us for complete information:

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1. It reduces particles to sub-micro-dimensions by grinding, and
2. Effects perfect dispersion of such particles into fluid or plastic materials.

An examination of the turbine design shows why it is possible for a single machine to perform these two distinct operations. Liquid is broken up into minute globules by high velocity impact at top of turbine. Suspended material is mechanically sheared by the rotor and stator teeth, and hydraulically sheared by the final smooth surfaces of rotor and stator.

Eppenbach Mills are available in laboratory and production sizes. Capacities range from ½ to 3600 gallons per hour or higher.

Write for complete details. Ask for a copy of Catalog No. 401.

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NEWS FROM ABROAD

GENERAL CUT IN FUEL SUPPLY FORCES CURTAILMENT IN BRITISH CHEMICAL PRODUCTION

Special Correspondence

TO AVERT the threat of individual production stoppages due to exhaustion of fuel stocks, the Minister of Fuel early in December decided on a general cut of coal, gas and electricity supplies to industrial consumers, at first by 2½ percent. Some chemical works are among the exempted essential plants, but even so, competent observers expect production, instead of continuing to increase, to decline by 3-5 percent as a result of the official restriction and inferior quality of such coal as can be produced.

Boiler conversion to oil, it now appears, will leave chemical works in certain port areas with easy access to imported petroleum products almost unaffected by the coal difficulties, but in more remote districts the effects of the coal and power cut are likely to be aggravated by the transport problem, at least until the end of February. Fuel stocks are very low in the British chemical industry. For manufacturers overwhelmed by a growing pressure of demand from most of their customers it is not easy to decide which branches of production are to bear the brunt of the cut.

A number of important price advances were effected in December, all due to official action. The maximum selling price of sulphuric acid, of strengths not higher than 155 deg. Tw. at 60 deg. F., was raised on December 9. The Ministry of Food prices for a wide range of refined vegetable oils were advanced with effect from December 8 in line with the earlier rise in cost of crude oils, and the quotations of a number of fatty acids were increased on December 1. A steep advance in the price of refined glycerine was announced for January 1, and at the same date the Molasses and Industrial Alcohol Control was expected to advance prices of alcohol, acetic acid, acetone and a number of solvents on account of a higher price ceiling for molasses.

The British domestic prices of non-ferrous metals and other commodities of international commerce have some time followed closely variations in world markets. Authorities delay price

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CORROSION-RESISTANT EQUIPMENT

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- Super-Jacketed Kettles — Stainless Steel, Pure Nickel or Monel
- Agitators — Stainless Steel
- Storage Tanks — Plain, Jacketed or Insulated — Stainless Steel, Pure Nickel or Monel
- Pulp Tanks — Stainless Steel
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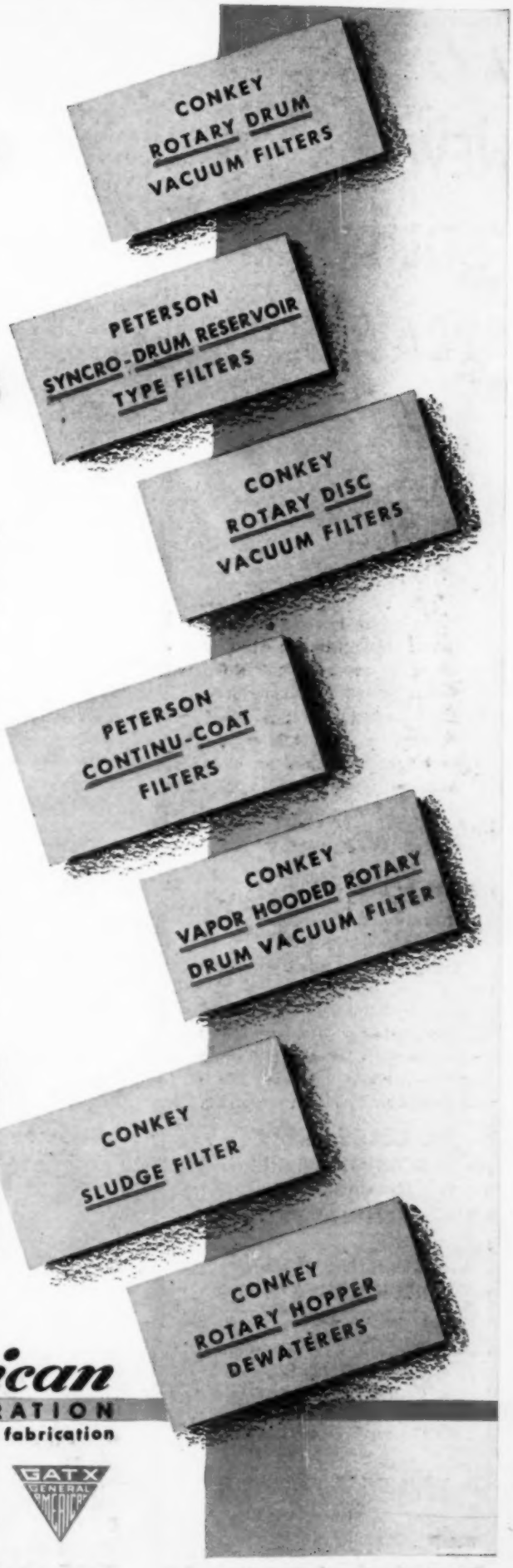
CONKEY ROTARY DRUM VACUUM FILTERS
PETERSON SYNCRO-DRUM RESERVOIR TYPE FILTERS
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GENERAL AMERICAN Conkey and Peterson filters comprise both vacuum and pressure filters in a wide range of sizes for continuous or batch filtration cycles.

Special features of design and construction are incorporated in the different filters which contribute to the end result of efficient, dependable performance.

A General American engineer, experienced in the design and operation of filtration equipment of all types will be glad to work with you toward modernizing your existing equipment or installing new units.

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Fig. H-530

Here is a new nozzle with two round tangential inlets (instead of several small slots) which permit relatively large solid particles to pass right through and out the orifice. Produces fine breakup, even distribution, and solid cone spray suitable for numerous applications.

Available in Brass, or made to order in any machinable material. 1/4" I.P.S. capacities from 12 to 75 gph @ 10 lbs. water pressure.

Send Monarch an outline of your spray problem — if the liquid can be sprayed with direct pressure at all — Monarch can furnish the nozzle.

NOZZLES FOR:

- ACID CHAMBERS
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- CHEMICAL PROCESSING
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Do you have our Catalogs 6A and 6C?

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advances if they still hold stocks bought at lower prices, but otherwise do not hesitate to charge domestic buyers with the full cost of imported and home-produced raw materials in accordance with proper commercial calculations.

This, of course, constitutes a marked deviation from the wartime policy of stable prices. It represents a new long-term policy, and though it cannot but cause some concern to British manufacturers, it is felt that any different price policy, which would in fact amount to subsidization of some industries at the cost of others, would in the long run isolate British industry from the world market and thus cause great harm to the country which depends more than ever on a prosperous world trade. Even with the recent officially-sanctioned price increases, the British market level is still below that of most, though not all, European and overseas countries.

A growing sense of realization in official quarters of the hard facts governing international trade is reflected, too, in advice given by the Board of Trade to British exporting firms to foster their trade with hard-currency markets instead of aiming at an indiscriminate expansion of all foreign sales. This directive was issued at a time when British overseas shipments reached a new pinnacle. In October chemical exports amounted to £6,545,179, a new post-war record, and unofficial reports say this high level, very welcome after the decline in August and especially in September, has been maintained since. The chemical trades thus stay in the forefront of Britain's export industries, but a large part of their foreign sales goes to Empire markets, or to countries in continental Europe which are unable to pay in kind for the goods they receive from England.

Excess of Imports

British commerce with the Empire and so-called weak-currency countries is now fairly well balanced, but exports to U. S. A., Canada, Argentina and other hard-currency countries are still far below British imports, mainly of food and raw materials, from this group of countries, so that, even with the U. S. and Canadian Loans, it seems doubtful, in the view of the competent authorities, whether the gap can be bridged in the next two or three years. Hence the insistence on priority in exports for dollar countries. At the moment it is too early to say whether the official appeal will be successful. In some quarters it is thought that British chemical manufacturers can help best to swell the country's dollar income by supporting other export industries and supplying Empire coun-

CASE HISTORY No. 11

One in a series of factual experiences of a group of American manufacturers with Multiwall Paper Bags.

COST COMPARISON
(Per Ton)

	Burlap Bags	100-lb. Paper Bags
Container cost	$2.00	$ .98
Labor cost	.36	.18
Total container and labor cost	$2.36	$1.16
Saving per ton, paper over fabric		$1.20

CLASS OF PRODUCT PACKED

CEMENT	FERTILIZER ✓
CHEMICALS	FOOD
FEEDSTUFFS	MISCELLANEOUS

PRODUCT CHARACTERISTICS

ABRASIVE	GRANULAR
CORROSIVE	HEAVY ✓
FLUORESCENT	HYGROSCOPIC
FLUFFY	LIGHT
FREE-FLOWING ✓	VISCOUS

ST. REGIS BAG PACKAGING SYSTEMS are made in a variety of capacities, speeds, and manpower requirements to suit specific products and plant layouts. Machines are available in types to meet the special characteristics of a wide range of products, with filling speeds as high as twenty-four 100-lb. bags per minute.

They struck it rich by changing to a

ST. REGIS PACKAGING SYSTEM

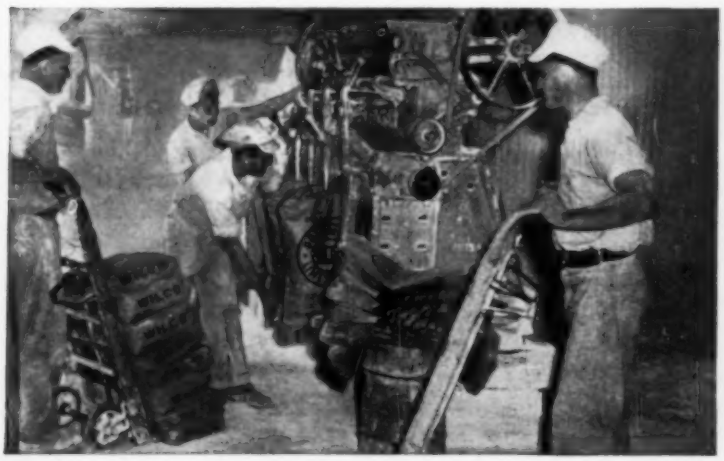
Surveying its packaging costs with a critical eye, a limestone mining company dug deeper into the facts and uncovered a rich "find"—considerably lower packaging costs and a better container for its product.

This company—Willingham-Little Stone Company of Atlanta, Ga.—mines and processes dolomitic limestone, which is sold primarily as a neutralizer for acid soils. Formerly the product had been packaged in burlap bags. Then the company changed to a St. Regis Packaging System (packer and multiwall paper valve bags). The economies resulting from this modern packaging system were far beyond expectations:

- Container costs were reduced by 51%; labor costs went down 68%—a total reduction of 55% in packaging costs!
- Packaging output jumped from 15,000 lbs. to 40,000 lbs. per hour—a 166% gain!
- Customers expressed enthusiastic approval of Multiwalls, noting that they virtually eliminated siftage and made a cleaner, easily-handled package.

This "case history" is one of many examples of the outstanding savings made possible by St. Regis Packaging Systems in the rock products, chemical, food, fertilizer industries. For the complete picture story of this efficient operation, mail the coupon to the nearest St. Regis office.

Left: The St. Regis 107-FC packer, which simultaneously fills and weighs 100-lb. multiwall paper valve bags.
Right: Four filling tubes permit uninterrupted packing.



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Without obligation, please send me full details regarding "Case History" No. 11, outlined above.

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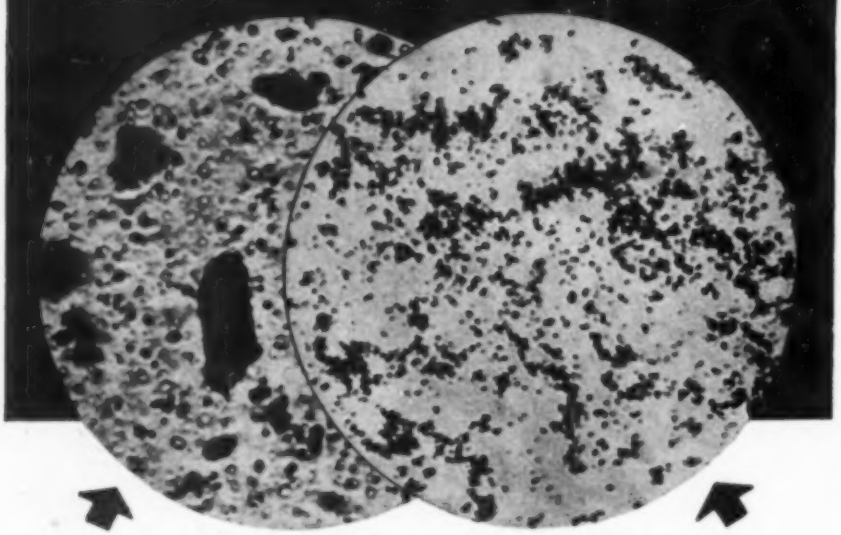
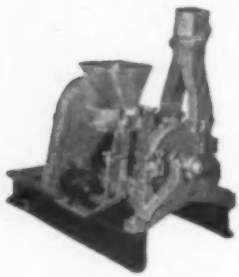


This photomicrograph (200x) illustrates the fineness of commercially produced pigments prior to the application of the MIKRO-ATOMIZER in 1946. The relative coarseness of the pigments required costly subsequent milling in the production of paints, lacquers and inks.

This photomicrograph (200x) illustrates the fineness of the same pigment when ground in a MIKRO-ATOMIZER. Most of the particles are 2 to 4 microns in size. This extreme fineness reduces the subsequent milling time of most paints, lacquers and inks by as much as 80%—and in some cases a finished product has been produced by a simple mixing of the Mikro-Atomized product and the vehicle.



No. 6 MIKRO-ATOMIZER

The ultra-fine grinds produced by MIKRO-ATOMIZER—a highly efficient, screenless, mechanical pulverizer—have proved to be of great advantage in the production of a wide variety of materials, other than pigments, that are subsequently to be used for either wet or dry dispersions. Our laboratory is prepared to make test grindings of your products, in the MIKRO-ATOMIZER, in order that you may determine the advantages of its application.

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MIKRO-ATOMIZER (ULTRA FINE)
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tries which, like Malaya, by their exports of primary commodities to North America earn dollars for the sterling bloc.

If 1946 is likely to enter British industries as the year of successful war-to-peace conversion, it is not by any means certain that 1947 will be the year of complete de-control, though some progress has undoubtedly been made in this direction. The output of chemical products in general falls short of present and anticipated requirements, stocks are at a low point, and expansion plans, many of them drawn up for a number of years ahead, are maturing but slowly.

More Synthetic Fibers

The biggest plans for extension announced this month in the chemical and allied industries concern the production of synthetic fibers and plastics. The British Nylon Spinners Ltd., the joint venture of Imperial Chemical Industries and Courtaulds, is going to raise its capital from £300,000 to £6,000,000, and most of the new money probably will go into the works now under construction at Pontypool in Wales. Courtaulds has spent £1,250,000 on buying the exclusive patent rights of the American continuous flow process for rayon spinning, and so great are the expectations based on this that the Chemical Workers' Union has asked Courtaulds to make this process available.

British Celanese also has announced a big expansion program to cost £6,000,000. While large sums are to be spent for new fiber factories at Wrexham in North Wales, in the Wigan district of Lancashire and on the English northeast coast, special interest from the chemical point of view attaches to the plan to increase output capacity for chemicals and intermediates at Spondon so as to provide the primary products needed in the new factories. Celanese also intends to expand in the pastics field, mainly in its special line of cellulose derivatives, but other synthetic plastics are receiving keen attention.

The insistence of Celanese on chemical production facilities of its own is by no means an isolated instance of "self-sufficiency" desires in British industries which are large consumers of chemicals. Rightly or wrongly some firms believe, especially now when chemical producers are hard pressed to strike a proper balance between the rival claims of their customers, that they would fare better if they made their own chemicals. Assured of a regular outlet for the whole of their output, such plants have certainly an economic advantage over independent firms, while on the technical side inti-

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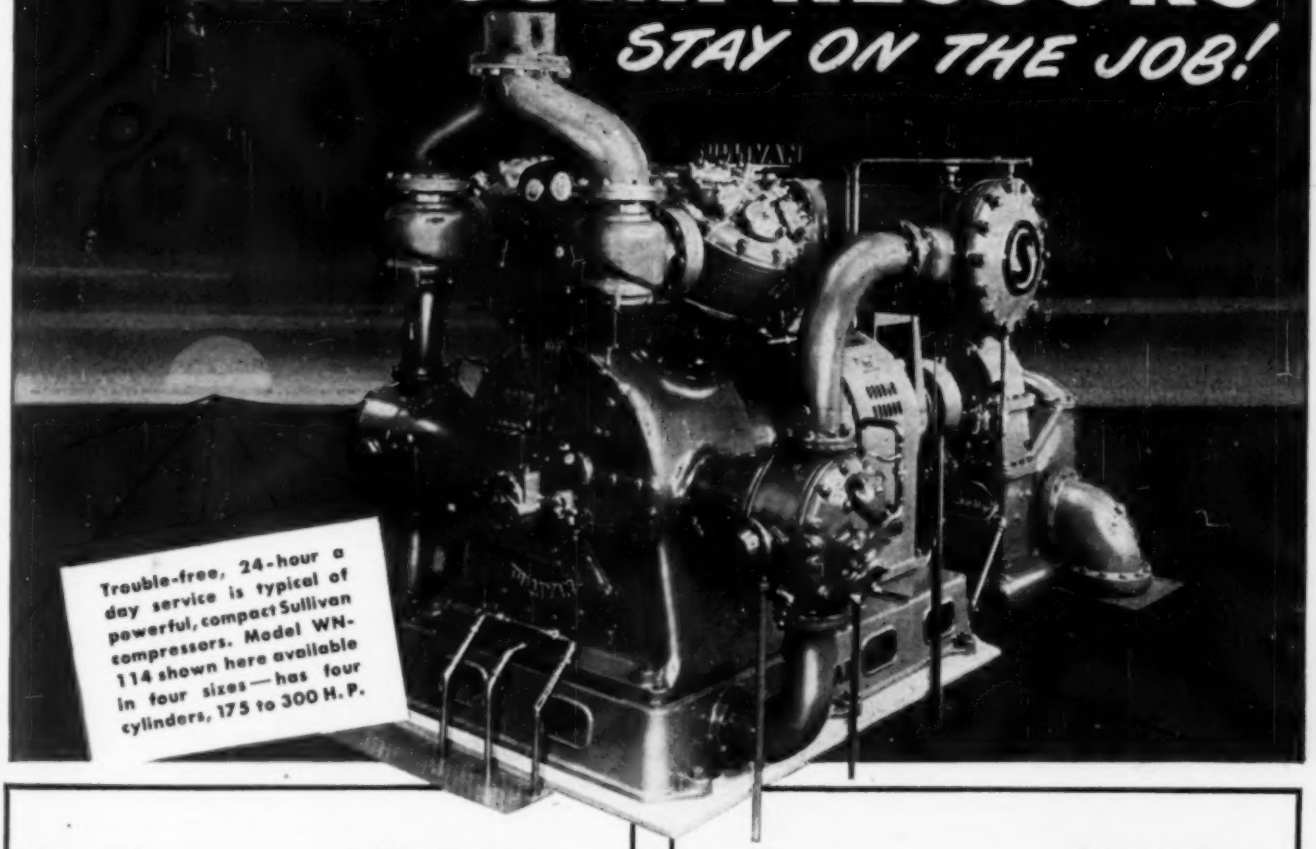
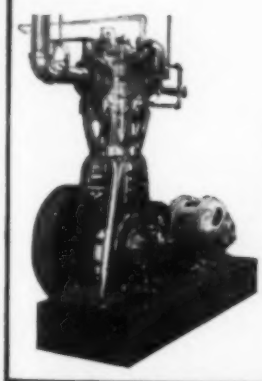
AIR COMPRESSORS
STAY ON THE JOB!



Trouble-free, 24-hour a day service is typical of powerful, compact Sullivan compressors. Model WN-114 shown here available in four sizes—has four cylinders, 175 to 300 H. P.



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Saves space and money

Single stage, double acting, water-cooled, vertical compressor that needs only a simple block foundation. Size with sheave only 3' x 2' 10" x 5' 10" high. Cylinder liners replaceable on job.

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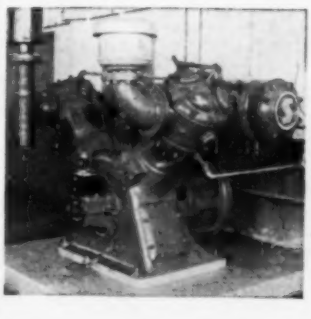

WN-112 COMPRESSOR

Two cylinder, V-vertical type. Double acting, water-cooled "Dual-Cushion" valves, full force feed lubrication, removable cylinders and cross-head guides. Six sizes—60 to 150 H. P.

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mate knowledge of requirements of their only customer facilities adjustment and adaptation.

This enforced specialization, however, prevents them from taking full advantage of current technical progress and saddles them with a thorny byproduct problem. Unfortunately, there is a danger that when demand falls off, consumers who cover part of their chemicals requirements in their own plants will tend to keep these in full operation and prune their purchases from outside sources.

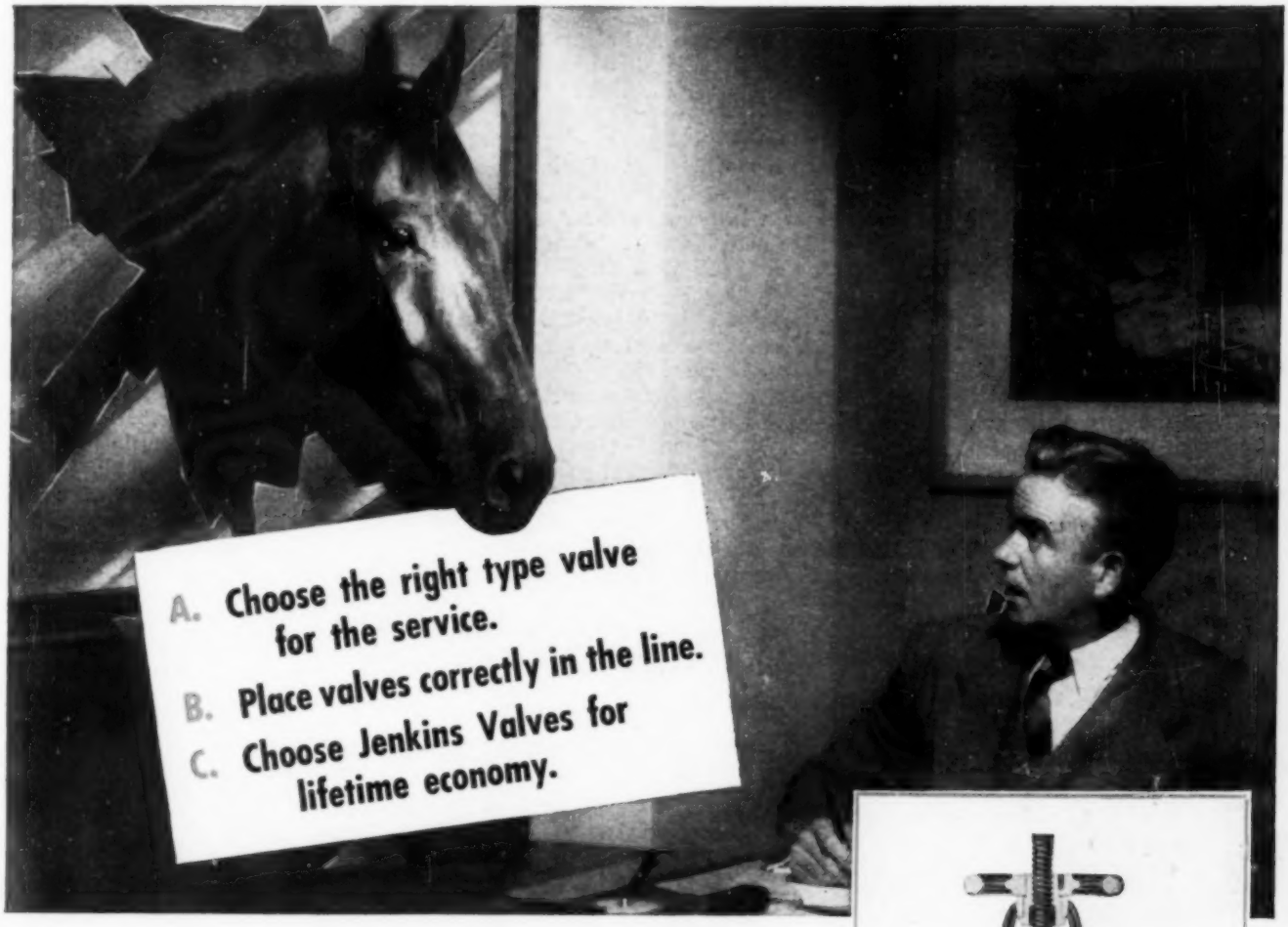
Latest official information indicates that plants set up in wartime are now covering all British requirements of certain chemical materials formerly met entirely by imports. Production of bromine from a plant in Britain can now supply all home consumers, so that statutory control no longer is in operation, while government stocks of fixed bromine are being disposed of by a leading private firm. In the case of calcium carbide British requirements are met from the government-owned plant at Kenfig, South Wales, apart from one other plant producing for private consumption. Substantial tonnages of ammonium nitrate are produced in government ordnance factories and used in substitution of more popular nitrogenous fertilizers now in short supply. The limited quantities made privately are for industrial purposes and for making nitro-chalk.

Material Shortages

Sulphuric acid, alkalis, materials for making plastics, phenol in particular, and fertilizers, copper and zinc are included in a list of commodities the production of which is only just sufficient in present conditions to cover the demand expected during 1947. Shortage of coal may seriously hamper alkali production, shortage of inland transport facilities may upset distribution of sulphuric acid, disturbing factors abroad may hold up fertilizer manufacture. Lack of stockpiles puts consumers of all these products in a very precarious position.

Even worse is the position of paint materials of which there is already a shortage, and lead is among the commodities the growing demand for which will certainly not be met in full. The official survey was undertaken to warn consumers in time and to encourage substitution. In the case of the chemical products in the list, however, there is little or no scope for replacement by other materials. For this reason and in view of the chemical industry's great contribution to the export drive it is hoped that special consideration will be given by the authorities to its special difficulties, particularly in fuel supply and transport.

For Valve Economy... this Formula makes Horse Sense


A. Choose the right type valve for the service.
B. Place valves correctly in the line.
C. Choose Jenkins Valves for lifetime economy.

YOU'RE in line for worthwhile savings in costs when you apply these simple rules.

Records show that wherever this formula has been used, and reasonable care given to valves, Jenkins Valves serve far beyond the normal life expectancy of valves, even under hard and constant usage . . . and with minimum maintenance costs.

By choosing Jenkins Valves, you not only make sure of extra value that means *lowest cost in the long run* but you also get the advantage of experienced counsel on the selection and placement of valves from Jenkins valve specialists. Base *your* buying on the Jenkins *ABC* formula next time you need valves.

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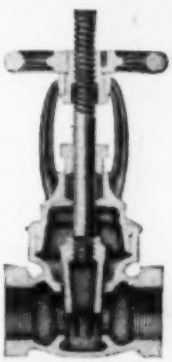

JENKINS Fig. 275
Outside Screw and Yoke
BRONZE GATE VALVE

Made with extra stamina to withstand effects of frequent operation and give long, trouble-free service. Rising spindle, with threads outside the valve where they are easily accessible for lubrication, serves as an indicator of wedge position. Spindle of manganese bronze. Yoke and bonnet cast as single unit for greater rigidity and strength.

ONE OF OVER 600 EXTRA VALUE VALVES MADE BY JENKINS VALVE SPECIALISTS

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Sold Through Reliable Industrial Distributors Everywhere

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SEAMLESS, STAINLESS
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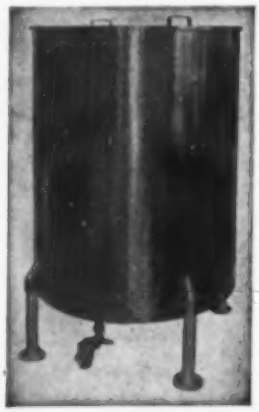

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Monel metal or stainless steel. Endless iron ring, handles attached, reinforces top. Bottom reinforced by iron cross welded to iron chime. 10 to 75 gallons.

DIPPERS

72 oz. with handle. Also some one, two and four - quart FLAT dippers.

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FRENCH CHEMICAL PROCESS INDUSTRIES MAKE PROGRESS IN FACE OF MANY UNFAVORABLE FACTORS

Special Correspondence

In every section of economic activity in France a notable increase has been registered in recent months. The upward surge seemed destined to continue but recently fears have arisen that progress will be slowed by cutbacks to be applied on consumption of electric power as a result of low water supplies. Coal and lignite production has increased even though the smaller number of working days brought the September output of 4,056,000 metric tons a little under the August total. Steel mills likewise are steadily increasing their outputs and the 419,000 tons reported for September was about 80 percent of the 1939 level. Other heavy industries are working back to their prewar normals.

An agreement was concluded some time ago whereby Belgium agreed to coke 75,000 tons of American coal for French account. First deliveries of this coke were scheduled to be made in December. Despite the improvised position of steel the supply is inadequate and manufacturers of equipment still are handicapped.

In the chemical industry spotty conditions prevail with a wide range in the degree of improvement made. For instance sulphuric acid has been made in larger volume with the September total of 75,000 tons comparing with a prewar monthly figure of 106,000 tons. More acid equipment is being overhauled for later operation but in the south of the country, rehabilitation of equipment has been retarded by the scarcity of lead. There is a heavy demand for hydrochloric acid and while production has been gaining the supply is not sufficient to meet requirements. Production in September was about 7,500 tons which compares with a 1938 figure of 10,000 tons.

In general the situation in alkalis is described as satisfactory and this applies especially to soda ash. Current production is of about prewar status as shown by the estimate of 39,000 tons produced in September. Sodium sulphate also is more plentiful but the September output of 3,000 tons is only 60 percent of the old monthly average. In the case of caustic soda the capacity for electrolytic has been increased as the September production of 1,000 tons compares with a prewar figure of 925 tons. Total production, however, is still far below the earlier standard as shown by the 7,000 tons produced

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Use any available space. Tail-blocks can be slung between posts and moved by hand—and mechanically moved on I-beam track, by tail-block car, or suspended from an aerial bridle system. The scraper and cable system is operated by *one* man through remote control. *One* company, Beaumont Birch, supplies all necessary equipment.

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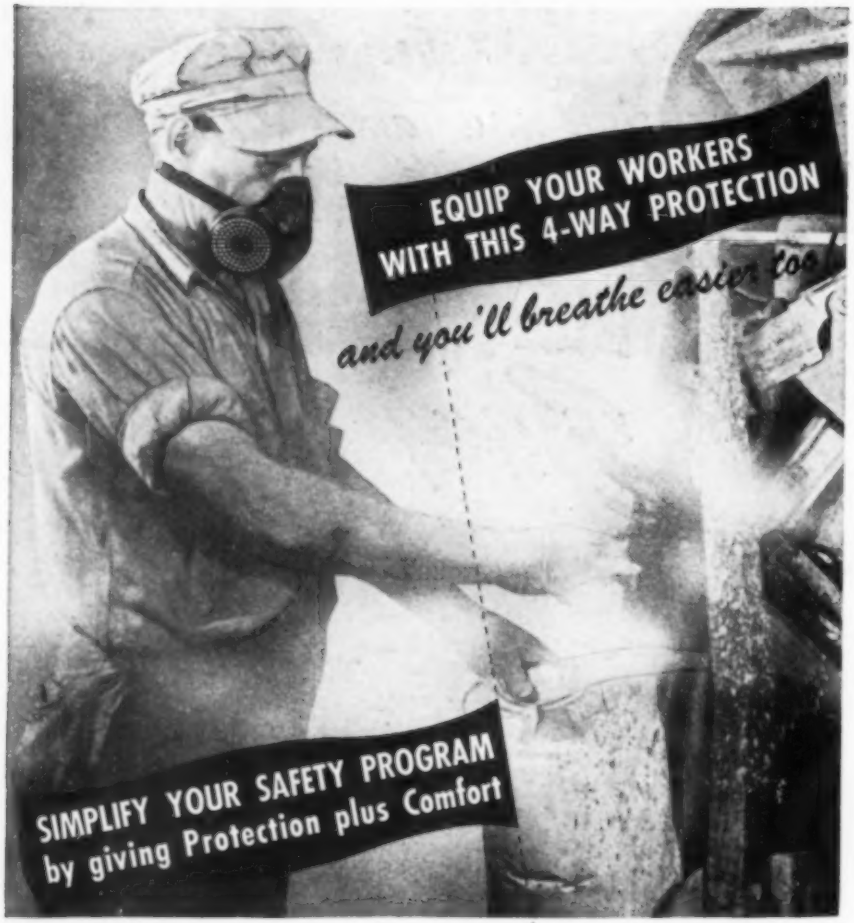
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WITH THIS 4-WAY PROTECTION
and you'll breathe easier too
SIMPLIFY YOUR SAFETY PROGRAM
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in September as compared with a normal total of 9,500 tons. Requirements for caustic are running considerably above current production with the result that consuming lines are restricted in their own operations.

Potash Mining

Operations at Alsatian potash mines have been speeded up and are running above the average 1938 rates. Production in September was reported at 309,000 tons as against the prewar figure of 277,000 tons. For the first nine months of this year, deliveries, expressed in terms of actual potash, were about 100,000 tons to home consumers and 35,000 tons for export. The call for caustic potash is relatively small owing to the drop in soap activities following the scarcity in fats and oils. The position of fats has improved somewhat with total supply for September given as 86,000 tons compared with 77,300 tons in the preceding month but the comparison is less favorable when it is considered that the prewar monthly supply ran as high as 125,000 tons.

Among the process industries making a very good record is glass. Current production is considerably ahead of the prewar rate. In the first place glass products were sorely needed and even the present large output is unable to fill demands so that the urgency of requirements should force a high rate of production for a long time to come. On the other hand paper production which recently started to move up had suffered a sharp decline and it will be some time before normal amounts become available. As a matter of fact whether present rates can be maintained or improved, depends on the future supply of pulp and pulpwood and at present this is uncertain. It has been suggested that the forests in Germany could relieve this situation.

Production of plastics varies according to the various types. Some of the molding powders, phthalic anhydride, and certain synthetic resins are offered in volume above that of prewar years but polyvinyl chloride has reached only about one-half its former level. Casein plastics which had assumed considerable importance in France, are now turned out only in a small way as may be gathered from the September production figure of 10 tons. There not only has been a critical shortage of casein but what supplies were available have been reserved for edible use. It is expected that this material will become more plentiful but the price is 16 times that of prewar and this may curtail its use industrially.

Pharmaceuticals were among the first of the chemical groups to stage a recovery and by the end of last

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Built—to last
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ENGINEERING. I·P·E equipment—both complete plants and individual units—incorporates advanced engineering. Result: equipment created *functionally* to fit your *own* process, simplified plant layout, and in many instances, a better product. This broad engineering experience has resulted in major improvements in standard equipment used by the process industries. I·P·E technological skills can, and do, incorporate both engineering and design improvements, especially where special equipment has been "tailored" to your particular manufacturing process.

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DESIGN. Advanced design improvements are an important feature of I·P·E process equipment. I·P·E designers strip equipment down to fundamentals, adding only those design improvements that add greater efficiency. This means lower maintenance cost, less trouble shooting, longer equipment life and less outage!

If Production Is Holding Up Your Orders—Remember I·P·E Delivers Equipment on Time

MANUFACTURERS ARE **being flooded with orders in these days of reconversion . . . particularly the chemical process industries. Even if full time production finds you unable to keep up with the avalanche of orders, consider this . . . let I·P·E analyze your production process . . . make suggestions that will help to step up your output through the addition of new process equipment.**

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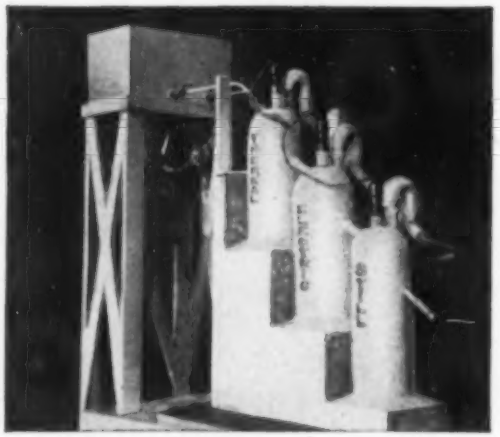
Internal Electrical Heating

Operable as Single Units or in Cascade



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year had regained their prewar status. Production in 1946 is expected to top the prewar average by from 30 to 40 percent. Manufacturing plants in this field were given preference in the way of fuel and raw materials and the result is that domestic requirements are being filled and there is a growing surplus which now is being diverted into export trade. In fact exports of pharmaceuticals are regarded as highly important in building up the economy of the country.

Tanning Materials

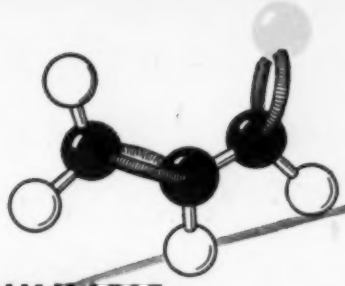
Leather plants are getting more of the chemical tanning materials such as sodium sulphide and bichromates but natural extracts are in limited supply and the cutback in shipments of quebracho extract from South America is severely felt. Pigments are reaching the market in a larger way especially zinc and titanium oxides. France had expected to receive large quantities of bones from India but the Indian Government has refused to allow such deliveries and manufacture of glue and gelatine is at a low ebb. Although rubber supplies are not up to earlier standards, tire production has grown.

The improvement reported for so many manufacturing industries has been accomplished in the face of numerous unfavorable factors. To begin with there has been and still is a shortage of coal, electric current and labor. The supply of trucks and railroad cars has not been brought to anything like requirements and this handicaps the inward movement of raw materials and the outward movement of finished products. This shortage resulted largely from the removal of trucks and cars to Germany during the time when the Germans were in control of the country. Incidentally there does not seem to have been any decision reached regarding the German plants that are to be moved to France as part of the reparations agreement.

In addition to the shortage of vehicles for transporting goods, there is a shortage of packaging materials and this is having a wide-felt effect. Glass containers are in heavy demand but the demand can not be satisfied and the movement of liquid materials is sorely affected. Barrels likewise are hard to get and this not only slows up many domestic lines of manufactures but complaints are heard that export orders can not be filled because of the packaging difficulty.

The trend of prices has been decidedly upwards and this is making it more difficult to negotiate export business. Some French prices are higher than those of the world market and exports can be made only where foreign markets do not compete.

ACROLEIN



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RESINS — As an intermediate in the preparation of polymerizable monomers, and as a constituent of aldehyde resins

INTERMEDIATES — As an intermediate in the synthesis of pharmaceuticals, heterocyclic ring compounds, polybasic acids, diamines, alcohols, acetals, etc.

AMONG THE HUNDREDS OF POSSIBLE REACTIONS ARE:

Chlorination $CH_2=CH-CHO + Cl_2 \longrightarrow CH_2Cl-CHCl-CHO$ (2,3-DICHLOROPROPIONALDEHYDE)

Acetal Formation $CH_2=CH-CHO + HCl + C_2H_5OH \longrightarrow CH_2Cl-CH_2-CH(OC_2H_5)_2$ (3-CHLORO- 1,1-DIETHOXYPROPANE)

Amination $CH_2=CH-CHO + (CH_3)_2NH \longrightarrow (H_3C)_2N-CH_2-CH=CH-N(CH_3)_2$ (1,3-DIMETHYLAMINOPROPENE)

Ring Formation $CH_2=CH-CHO + CH_2=CH-CH=CH_2 \longrightarrow$ (TETRAHYDROBENZALDEHYDE)

$CH_2=CH-CHO + NH_3 \longrightarrow$ (β—PICOLINE)

PROPERTIES	
Chemical formula	$CH_2=CH-CHO$
Molecular weight	56.06
Specific gravity	0.84
Melting point	—86.9° C
Boiling point	52.7° C
Colorless	
Inflammable	
Soluble in alcohol, ether	

To members of the chemical industry who are interested in its many potential uses, we offer trial lot quantities of Acrolein for use in the development and processing of new commercial products.

The bifunctional Acrolein molecule is extremely versatile. It can undergo an almost unlimited number of reactions characteristic of both aldehydes and activated olefinic bonds to form a variety of unusual compounds. Your investigation of these many possible reactions may afford new and profitable applications of this chemical.

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3. Easy accessibility to working parts cuts down "out-of-service" time. It is not necessary to disturb piping, power unit, or pump mounting to inspect or replace gears, case, bearings or packing.

Send for Bulletin of Pumping Facts.

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Builders of Pumps for Manufacturing, Marine, Petroleum and Process Industries.

Capacities ¾ to 300 G.P.M.; pressures up to 1000 P.S.I.; speeds up to 1800 R.P.M.

ROPER Rotary Pumps

ATOMIC ENERGY RESEARCH STARTED IN INDIA

Special Correspondence

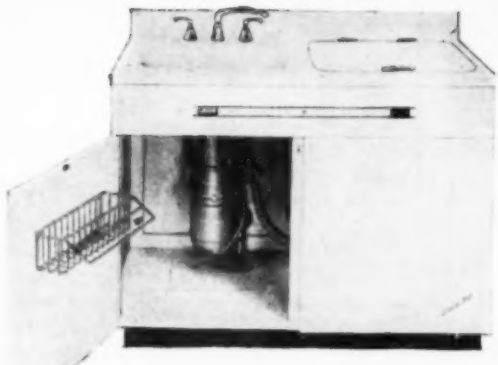
SPONSORED by the Indian Council of Scientific and Industrial Research, a five-man atomic research committee has been set up in India. At its first meeting, with Dr. H. J. Bhabha as chairman, the committee recommended: A thorough geological and physico-chemical survey of uranium-bearing minerals and thorium deposits in India; an export ban on monozite sands of Travancore; highest priority and government support of large-scale development of atomic research; because of relatively low funds available, that all large-scale nuclear research be concentrated at one center; all universities be encouraged to train a large number of workers in the theory and experimental technique of atomic physics; annual conferences of all research workers be held; and existing centers of atomic research—Calcutta University, Tata Institute of Fundamental Research, and Bose Research Institute—be strengthened.

Research Programs

A high power betatron capable of producing electrons of energies up to 200 million volts is being set up at the Tata Institute at Bombay, the Nuclear Research Laboratory at Calcutta University has been granted a large sum of money, and a research program on trans-uranic elements, nuclear fission, and absorption cross-section of neutrons has been financed at Bose Research Institute in Calcutta.

The mineral sands or beach minerals of Travancore in South India are the richest in the world and more than 75 percent of the world supply of thorium comes from these sands. At one time, Travancore had a flourishing trade in coconut coir with Germany. Spinners impregnated the coir with monozite sand to give weight to the rope and the discovery of this sand in German warehouses led to the commercial exploitation of the sand. With German capital, the London Cosmopolitan Mining Co. began operations in 1911. In 1914 the company was reorganized and became the Travancore Minerals Co. with Great Britain in control.

The mineral sands occur over a stretch of 15 miles along the Arabian seacoast and vary widely in mineral composition. A good washing contains as much as 95 percent minerals of which 80 percent is ilmenite and the rest zircon, sillimanite, rutile, and monozite. Monozite is separated by combined electro-magnetic and gravity methods. Main constituents of monozite are the phosphates of the cerium metals containing thorium. Meso-



TOLERANCE PROBLEM in STAINLESS STEEL CASTINGS

Shredder Element for General Electric DISPOSALL . . . . .

PROBLEM:

Cast in quantity Shredder Element of Specified Intricate Alloy.

- Rough casting surface below cutters must be concentric within .020
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These Shredder Elements . . . cast in a complex abrasion and corrosion resisting high chrome iron alloy . . . had to be not only hard, but round in shape to a tolerance much closer than commercial castings . . . yet Cooper solved this tough casting problem and was in production after only 28 days!

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Cooper's unusual ability to produce sound corrosion resisting Stainless Steel Castings in quantity to the most rigid specifications is the result of vast technical experience plus practical shop skill. Today, Cooper is the largest Stainless Steel foundry of its kind with all facilities located under one roof.

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A 2000 pound Pressure-Tight High Alloy Casting Assembly

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Statically Cast Return Bends

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Centrifugally Cast Tubes

This is the "coil" of a special heat exchanger alloyed and cast for a large company in the Rocky Mountain area. It's an excellent example of the kind of work our metallurgists and foundrymen are capable of turning out.

Backed by 25 years' experience with high alloy static castings and 16 years with centrifugal castings, we are in a position to produce any chrome-iron or chrome-nickel casting within the range of our electric furnace capacity—namely, about 4 tons for any one pour. We have an X-ray testing machine. We can finish the casting to any degree desired.

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thorium is obtained as a byproduct and is a radioactive substance similar in composition to radium.

SEVEN POTASH PLANTS NOW OPERATE IN HANNOVER

WRITING from Berlin, the McGraw-Hill World World News says that the seven potash plants now in operation in the Province of Hannover, Germany, can produce up to 40 percent of the amount of prewar agricultural consumption. Maximum production was achieved in July, when the output was 19,000 metric tons of potassium oxide, or 40 percent of the normal figure for that month. It is expected that production will show even greater improvement when equipment in plants not in operation can be repaired and replaced.

If additional workers could be obtained for the coal industry, the entire current demand for the product in the British zone could probably be met, and also the conditional export quota of 30,000 tons.

ARGENTINA MAKES CHANGE IN CUSTOMS PROCEDURE

AN UNOFFICIAL report from Buenos Aires says an important change in customs procedure went into effect in the Argentine on January 6. The new regulation makes it necessary for importers, in order to clear goods through customs, to present the original bill of lading, legalized commercial invoice in duplicate, and legalized consular invoice in duplicate. An importer is subject to a 2 percent fine if the bill of lading is not presented to the customs within eight days of the steamers arrival. Formerly importers were allowed to store goods at customs without documents, were granted a six-month period for presentation of documents and could release goods without documents under a bank guarantee.

AUSTRALIAN COMPANY WILL PRODUCE LUMBANG OIL

DEVELOPMENT of the oil of the lumbang or candlenut tree as a substitute for linseed oil in the manufacture of paints was started in the Fiji Islands in 1942 by a Melbourne concern, Industrial Oils (Fiji) Ltd. The £40,000 firm is now seeking an increase in capital. The company claims an expanding market, at profitable prices, in Australia, New Zealand and other countries.

So far, only an experimental extraction and refining plant has been in operation, producing about 200 gal. a week. A new plant now under construction in Australia is expected to raise output to 1,200 gal. a week.

Is Activated Carbon the answer to your Adsorbent Problems?

the most versatile adsorbent for solving problems of

Air Conditioning
Solvent Recovery
Gas Purification
Deodorization
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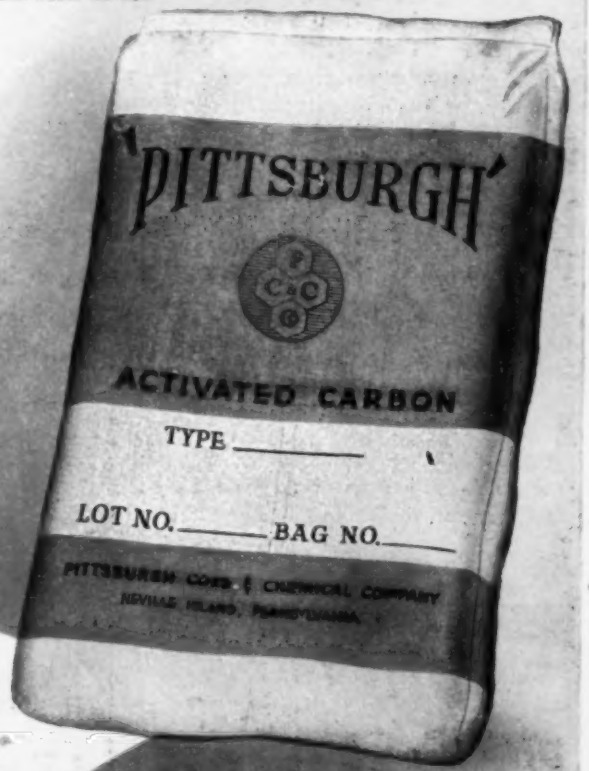
Fractionation
Isolation of Organic Chemicals or Drugs
Catalysis or Catalyst Carriers

The technology of modern manufacturing embraces, in ever increasing degree, application of the science of chemistry as well as the mechanical forces of physics. Likewise the accomplishment of a physical act through a chemical medium becomes more and more common practice. Solving problems of adsorption is a typical sample of this method.

Of the various adsorptive materials, Activated Carbon has proved to be exceptionally adaptable and versatile. It has high adsorptive capacity, is chemically stable, readily regenerated and can be made in a variety of forms and sizes to meet specific needs. Moreover it can be produced relatively economically on a tonnage basis for large scale applications.

If your manufacturing process requires the use of an adsorbent you should investigate the merits of Activated Carbon. Pittsburgh Coke & Chemical Company has the technical "know-how" and the production facilities to help you. Ask us to!



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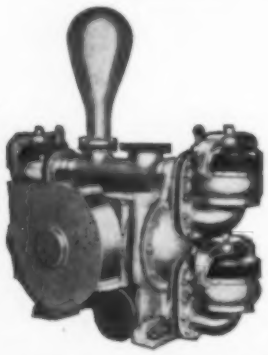
WITH HARD-TO-HANDLE MATERIALS



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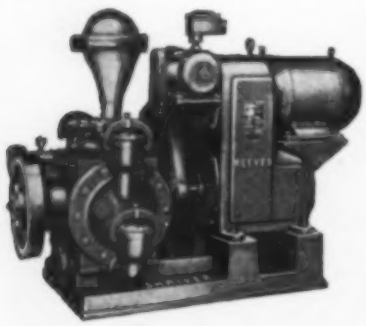
Shriver Diaphragm Pump does not expose operating mechanism to material handled. Large liquid heads with ample valve clearance, built of any metal or rubber covered. Capacities to 100 gpm. Pressures to 100 psi.



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Pump easily handles latex, viscous or quick-settling materials; easy to inspect and clean; no leakage.

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GERMAN CHEMICAL INDUSTRIES

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Large Scale Production of Oxygen and Atmospheric Gases—This report reviews the production of oxygen and other gases from the atmosphere by the Linde-Frankl process. Altogether, 73 Linde-Frankl units have been erected by the Linde company since 1930, with an average capacity of 2,378 cu.m. per hr. of oxygen of 98 percent purity. The oxygen has been used mainly in the complete gasification of coal. In some cases, pure nitrogen was separated simultaneously with oxygen and used for ammonia synthesis. The plant at Leuna was also equipped for the recovery of krypton. The arrangement of the plant and method of operation is described in some detail, with reference to the installation of Leuna. Variations in design are discussed with reference to units of two different types of the A.S.W. works at Böhlen. An analysis is made of available information relating to energy requirements of the process. An attempt was also made to determine the cost of oxygen production by the Linde-Frankl process. Flow diagrams for the production of oxygen, nitrogen and krypton, together with a few miscellaneous diagrams are given. A few tables and a graph are given. (A. M. Clark, PB 41229; July 1946; 29 p.; M. $1; P. $2.)

Synthesis Gas Purification Processes in Germany—This report records information obtained by technical investigators on processes for the purification of gases in Germany for their subsequent use in chemical and synthetic fuel production purposes. It covers those processes which are in commercial use for the purification of large volumes of gas such are employed in the production of ammonia, hydrogen, methanol, and synthetic oils. The report describes the several processes studied and the factors controlling them. The emphasis has been on those parts of the processes which are not commonly known in the United States, the more common elements having been eliminated. The topics considered are: Dusts and tar removal; I. G. Alkazid process for gas purification; I. G. Claus process for recovery of sulphur from H_2S; H_2S removal with iron oxide; removal of organic carbon, carbon dioxide, and carbon monoxide; and gas purification by activated carbon. (W. H. Lyon and R. M. Crawford, PB 40925; Aug. 1945; 16 p.; M. $1; P. $2.)

New Synthetic-Resin Glues for Wooden Airframes—This is a translation of a German document. An investigation was made of five different cements regarding their suitability for wooden airframe construction. AS-glue, P-600, and Pertunol are phenolic-resin glues; the Polystal glue was prepared from diisocyanates; and the Pressal glue was prepared from melamine resin. The report gives results of strength tests on cold-glued spliced and lapped natural-wood, plywood and laminated wood specimens exposed to various conditions of temperature

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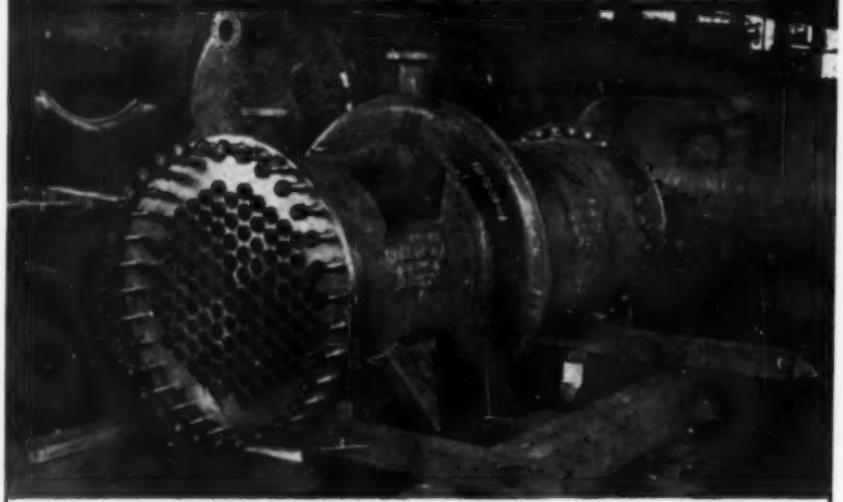

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and moisture. The rapidity with which the adhesives set at 20 deg. is compared with the corresponding data for Kaurit. Tables, graphs and a diagram are included in the report. (Kilch, PB 38053; Aug. 1946; 10 p.; M. $1; P. $1.)

Ion Exchange, Coatings, and Plywood Resins at I. G. Farbenindustrie, Th. Goldschmidt A. G., Permutit A. G., and Chemische Werke Albert—The important German producers of ion exchange and coatings resins were interviewed and this report presents a representative if not complete picture of German practice. Some information on plywood resins is also included. Much of the report is concerned with "Wofatit" ion exchange resins. A visit to the I. G. Farbenindustrie Wolfen plant resulted in obtaining the following: Diagram of Bemberg copper recovery unit (for recovery of copper from cuprammonium process waste waters); preparation of Wofatits (report in German, being signed by Dr. Wassenegger, Wolfen, July 31, 1945), Wofatit M being the only anion exchanger; diagram of Wofatit plant; Wofatit M production equipment (diagram); sketch of typical Wofatit unit; questions on Wofatits (answers by Dr. Richter); questions pertaining to the construction of Wofatit filters, being a translation of an article by Dr. Richter, Wolfen, Oct. 18, 1940, entitled "Konstruktive Fragen beim Bau von Wofatitfiltern." Additional information on Wofatits and other ion exchange resins was obtained by visits to other I. G. plants, a visit to the Permutit A. G., Berlin, and the interrogation of Dr. Arthur Splittgerber, Berlin, consultant on water conditioning in Germany. The scope of application of the Wofatits was quite varied and great emphasis was placed on nonwater conditioning uses. The I. G. Filmfabrik plant at Wolfen was also visited to obtain details of silver recovery from waste solutions resulting from photographic film manufacture. The process is described in an article in German by Mr. Rössler, and drawings are included. Otto Jordan, Griesheim, was interrogated regarding the plasticizing of polyvinyl chloride and air-drying urea-formaldehyde coatings. The Chemische Werke Albert, Wiesbaden-Biebrich was visited regarding their coating resins. The report gives the manufacturing procedures for all their important coating resins and some plywood resins. This includes Albertols, Durophens, Alftalats, Alresats, and Alresenes. A report, in German, describes the manner in which their glue "Albert-Leimharz 319J" is to be used. Information is also contained in this report concerning Tego glues manufactured by Th. Goldschmidt A. G., Essen. These are thermosetting phenol-formaldehyde resins used for bonding wood to aluminum or aluminum alloys. Directions are also given for the use of Polystal U, an I. G. Farben glue, the directions being provided by the Uerdingen plant; and the ion exchangers of the I. G. Farben Leverkusen and Ludwigshafen plants are covered. The report lists additional references which are pertinent to the subject. (F. J. Myers, PB 42802; Feb. 1946; 59 p.; M. $2; P. $4.)

The Thermal Expansion of Glass Substitutes—This report from the "Institut für Werkstofforschung der Deutschen Versuchsanstalt für Luftfahrt E. V." discusses the results of tests for determining the thermal expansion of glass substitutes such as "Plexiglas," "Astralon" and "Reilit" and gives the expansion coefficients for these substances for a temperature range from —70 deg. to 60 deg. C. Two graphs and a table are included. (H. Perkuhn and W. Kilch, PB 36189; Mar. 1941; 6 p.; M. $1; P. $1.)

Concentration Meters for Electrolytes Containing Zinc Chloride—An apparatus was needed which would indicate when a certain concentration of zinc chloride was reached. Two such instruments, based on different principles, were developed. One is based on the

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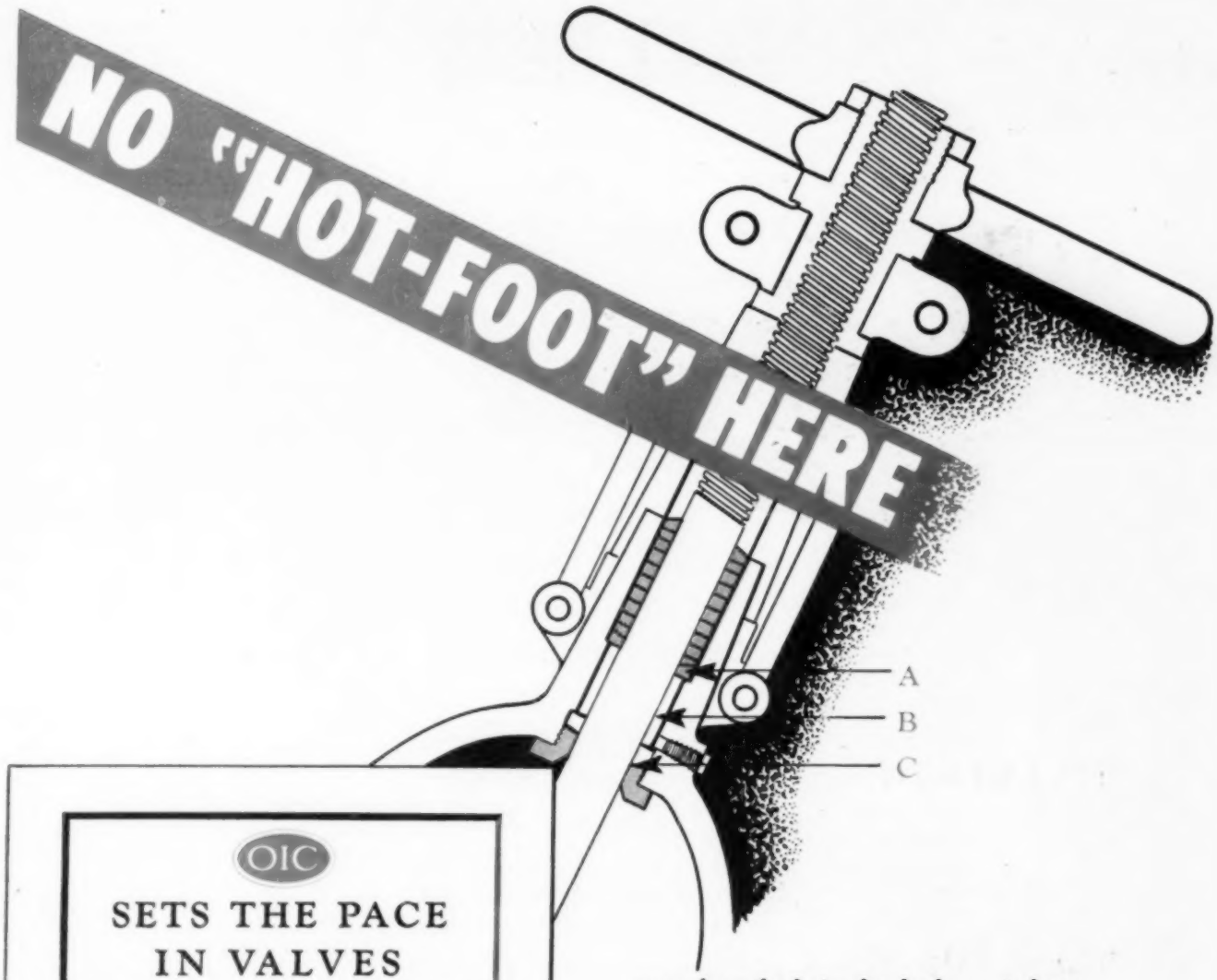

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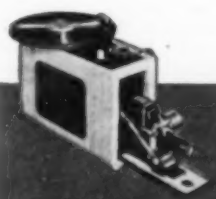

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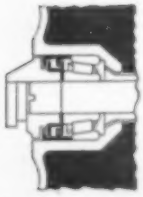


POSITIVE BEARING PROTECTION

Five pass labyrinth grease seals prevent foreign matter from entering bearings and keep grease from being thrown out. This assures longer life and better performance with less maintenance attention.

INVERTED "V" CONSTRUCTION

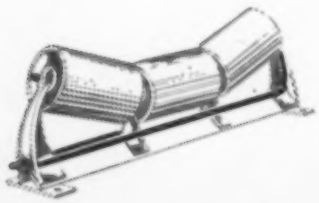
Basic design of Continental Idlers is the inverted "V." Spillage of materials over edge of belt—even wet sand and cement—shed off like rain on a steep roof. No more pilling up of spilled materials to interfere with proper performance of the rolls.

PATENTED NUT

Patented malleable iron nut has several functions. Provides accurate means of adjusting bearings; forms one passage of labyrinth grease seal; spaces and protects inner grease seals. Socket recess in nut fits over supporting bracket to tie brackets together and at the same time allows rolls to be easily removed.

RUGGED STRENGTH

Heavy ribbed certified malleable brackets to absorb shock are jig-welded to heavy angle base. Socket recess in patented nut ties rolls to bracket, gives the practical equivalent to one-piece construction throughout.



EASE OF LUBRICATION

Extended grease pipe from center roll is standard construction. This permits greasing of all rolls from outside for safety. All grease pipes may be extended to one side for convenience. Alemite button head fittings are standard.

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measurement of the rise of density, the other on that of the electrical conductivity of the solution. Diagrams are included. (H. Ebert and O. Kubaschewsky, PB 37112; Jan. 1945; 15 p.; M. $1; Print $1.50.)

Production of Caustic Potash in Mercury Chlorine Cells, I. G. Farbenindustrie, A. G.—South Bitterfeld—The purpose of this investigation was to determine the main differences in design and operation of mercury cells in the production of caustic potash liquor, as compared with that for the production of caustic soda. Potash has been made commercially in only one mercury cell plant in Germany. The operation is similar to NaCl electrolysis but is more critical with respect to brine purity, current density limitation of 2,400 amp. per sq.m., and increased electrode spacing of approximately 2 mm. Current efficiency averages 93 percent, cell voltage 4.3 and hydrogen 1.8 percent. Cost data for the first quarter of 1945 are tabulated. (W. C. Gardiner and others, PB 40122; June 1946; 10 p.; M. $1; P. $1.)

Sodium Sulphate Electrolysis with a Mercury Cathode—Sodium sulphate, contaminated with organic matter, is a byproduct of rayon manufacture. Its utilization through electrolytic production of NaOH and H_2SO_4 was investigated at the I. G. plant at Bitterfeld. This document contains a translation of a research report and results of an interview with Dr. Hëlmann the chemist in charge of the project. His report may be translated "Sodium sulphate electrolysis with mercury cathodes" and is dated Aug. 13, 1943. Among the methods investigated, the one employing a vertical-flow mercury cathode, a lead-silver anode, a microporous rubber diaphragm, and a current density of 1,000 amp. per sq.m. is considered to be the most promising. The products are 50 percent NaOH and 250 g.p.l. H_2SO_4 containing 230 g.p.l. Na_2SO_4. An outline of the work done and suggestions for further research are presented. Charts, drawings and photographs are reproduced. (W. C. Gardiner, PB 34812; June 1946; 29 p.; M. $1; P. $2.)

Schmidt-Meissner continuous Nitrators for Liquid Explosive Manufacture—This report describes the design and operational functioning of the Schmidt-Meissner nitrators for the production of such liquid explosives as NG (nitroglycerine) and nitrated diglycols by a unique and novel process. The three nitrators described are those procured by the Navy from the Benefeld plant of ELBIA, Bomlitz, Germany. The report contains a translation of a statement by Dr. Werner Schmedding on the operation of the Schmidt-Meissner continuous nitrator and translation of the recommendations made by Heinrich Knopf, maintenance engineer. Detail drawings of the equipment and buildings in which the units were originally installed are included as well as parts lists of such equipment. (C. H. Brooks and others, PB 39480; Oct. 1945; 74 p.; M. $1.50; Prints $7.50.)

The Porcelain Enamel and Ceramic Color Industry in Germany—This report reviews the information obtained during an investigation of German porcelain enamel and ceramic color plants and laboratories, and summarizes the most important developments of this industry, which were in most cases caused by a lack of conventional raw materials during the war. With respect to porcelain enamels, the frit "V26," containing titanium, is used in all borax-free enamels in Germany, and is said to be the outstanding development that kept the German enamel industry alive during the war. With respect to ceramic colors, production and research in this field were at a virtual standstill during the war due to the fact that the coloring oxides of cobalt, nickel, manganese, cadmium, etc., were put to more effective uses in the armament program. (C. J. Harbert, PB 40316; July 1946; 74 p.; M. $2; P. $5.)

Wet and Dry Chlorine vs. Materials of Chemical Plant Construction

Part I of a two-part symposium in which representative manufacturers of corrosion resistant materials discuss the suitability of their products for equipment exposed to wet and dry chlorine gas and chlorine water.

LEAD

H. M. CHURCH
Lead Industries Assoc.
New York, N. Y.

LEAD is recommended as a material for handling moist chlorine up to 230 deg. F. with slight corrosion, and the chemical when dry has very little effect on lead. Small amounts of chlorine, such as are used in water treatment, have no effect on lead. For handling hydrochloric acid, the use of lead is not generally recommended, but at normal temperatures there is only slight corrosion in concentrations up to 30 percent, and at 212 deg. F. concentrations as high as 20 percent have been used. Thus, when chlorine with some moisture present results in the formation of small amounts of dilute hydrochloric acid, there is a possibility of slight corrosion depending in amount upon other conditions.

Chlorine is a gas at room temperature and is inert to most metals when cool and dry, but the dry gas when heated attacks all metals to a certain extent. Hydrochloric and hypochlorous acids, formed in the presence of moisture, attack most metals except platinum, silver, lead, and certain special alloys. A protective layer of lead chloride forms over the lead and further corrosion is resisted while the film remains intact. This protective film permits lead's use with moist chlorine up to 230 deg. F. with only slight corrosion.

Lead pipe is used to introduce chlorine, gas or liquid, into a bath of caustic in a concrete tank in the manufacture of sodium hypochlorite. Pure lead tubing gives satisfactory length of service without undue expense. In general, at room temperature, corrosion of lead by wet or dry chlorine, either liquid or gaseous, is sufficiently moderate to recommend its use from an economic standpoint.

In nine years time, there has been apparently no attack on lead-lined settler tanks of 40 and 50-ft. dia. where a solution containing 1.9 g. per l. of chlorine, with other corrosives, is handled. This solution is at approximately 125 deg. F. and is saturated with sulphur dioxide.

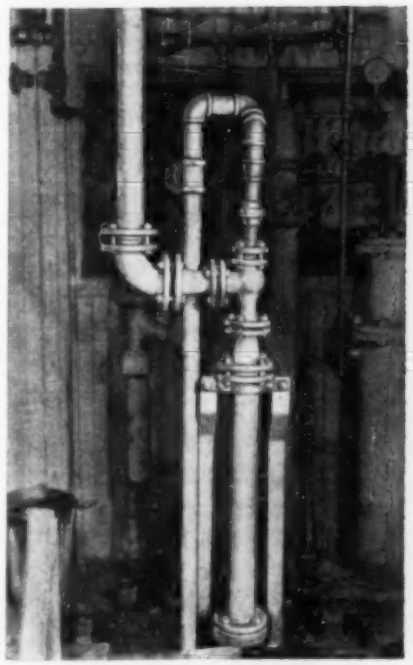
Relatively rapid corrosion takes place if lead contains a trace of chloride or is immersed in a relatively strong solution of a chloride and is subsequently exposed to the air. This is the result of a catalytic action in which the chloride acts as an intermediary with the formation of sodium carbonate and lead chloride which is subsequently attacked by the moisture and carbon dioxide in the air to form lead carbonate and sodium chloride.

HIGH-SILICON IRONS

J. L. TRAUB
The Duriron Co.
Dayton, Ohio

HIGH-SILICON irons have long been familiar to the chemical industry as materials of construction where resistance to corrosion is a prime consideration. Both of the common analyses, that is, 14.5 Si, 0.75 Mn, 0.90 C. max., and with or without 3 percent Mo, have been found satisfactory for certain applications in the handling of chlorine gas, wet and dry, and chlorine water.

Handling of dry chlorine gas presents no particular problem from the standpoint of corrosion as it is inert to most metals and alloys, including the high-silicon irons. However, since chlorine gas is rarely reacted in the dry state with dry materials the process engineer must consider materials of construction which will be relatively unaffected by chlorine gas either dry or wet, solutions of chlorine in water or organics and the reaction products. Under these conditions the high-silicon irons, particularly the one containing molybdenum known as Durichlor, have proved themselves as economical alloys from which to build process equipment provided hot, wet chlorine gas or mixtures of steam and chlorine are not involved. An unfortunate limitation of the high-silicon irons is that the alloys



Duriron ejector, fittings and pipe. Chlorine gas enters from side, water from top. Resulting chlorinated water goes down to pulp bleaching tanks. Ejector nozzles last about 6-7 mo., ejector bodies about one year. Fittings and pipe have never been replaced.

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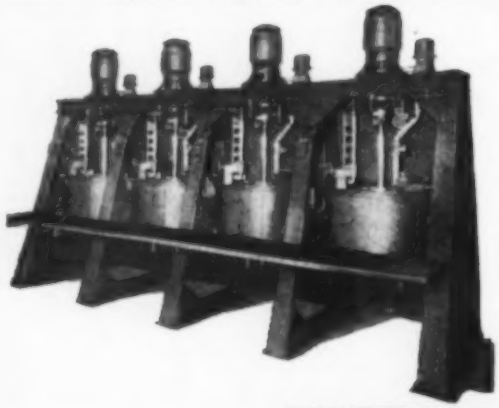

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are available in the form of castings only and due to their extreme hardness can only be finished by grinding. However, in spite of these limitations The Duriron Co. has produced a wide range of equipment in these two alloys which has been used for a number of years in handling chlorine, chlorine water and associated chlorine products. This equipment consists of centrifugal pumps, valves, pipe and fittings, fans, ejectors, mixing nozzles, distributor heads, and special castings.

Applications

The range of applications of the high-silicon irons includes the following:

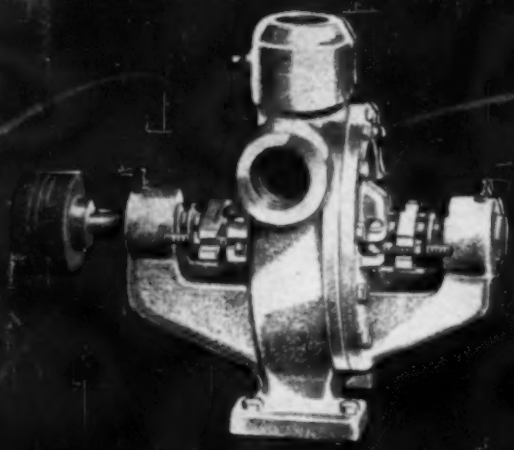
1. Treating of city water supplies by mixing chlorine gas with water in a high-silicon iron ejector. Chlorine concentrations of 0.3-0.4 percent free chlorine in the water are normal. Service life ranges from 2½ to 10 yr. depending on such conditions as water temperature and velocity, and solids in suspension.

2. Treating of paper mill water for slime control. In this application ejectors, pipe and fittings and distributor heads are furnished in high-silicon iron. The conditions are much the same as those encountered in treating of municipal water supplies.

3. Bleaching of paper mill pulp in water suspension. In this service Durichlor is usually the more economical alloy. Bleaching is carried out by producing a super-saturated water solution in an ejector and then introducing the strong chlorine water into the pulp through distributor pipes. The super-saturated chlorine water has been reported as ranging from 57½ lb. of chlorine per 1,000 gal. of water to as high as 100 g. of chlorine per liter of water. Under these conditions service life of the ejectors ranges from 6 mo. to 2½ yr. The water velocity through the jet appears to be the chief factor affecting the service life. In this service not only the ejectors are made of high-silicon iron but also valves, pipe and fittings. In one case reported, high-silicon iron pumps are handling chlorinated pulp without evidence of corrosion after years of service.

4. Chemical process industries. In this general classification high-silicon iron equipment is used for introducing chlorine gas into brines, into hydroxides for production of hypochlorites, into organics for production of chlorinated paraffins and similar chlorinated compounds, and also for handling the products of reaction which may contain free chlorine.

In conclusion it may be stated that the records of The Duriron Co. show the successful use of high-silicon iron



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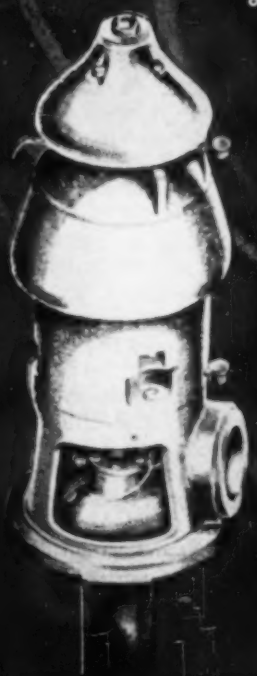

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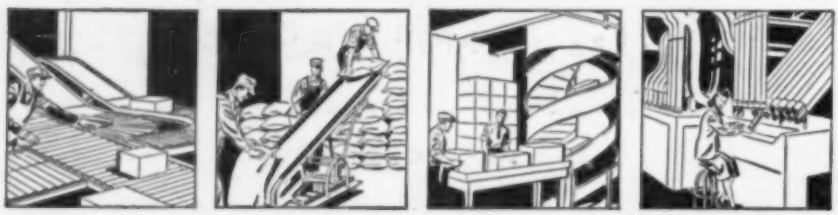

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equipment in the particular corrosive conditions under consideration, with the limitations given, extends back over a period of more than 25 yr. In general it has been found that the newer high-silicon alloy containing 3 percent molybdenum (Durichlor) is more economical for handling wet chlorine gas and chlorinated water. However, there are exceptions to this rule and each application should be considered on its own merits.

CHEMICAL PORCELAIN

JOHN S. CHOWNING
Lapp Insulator Co.
Le Roy, N. Y.

AS A MATERIAL of construction, chemical porcelain is stable in the presence of all chemicals except hydrofluoric and concentrated phosphoric acids, and hot strong alkalis. Because of its remarkable chemical stability, it finds great usage in the presence of chlorine, and chlorine in combination with a great variety of other chemicals.

For example, in the electrolytic manufacture of chlorine gas, porcelain piping and valves are used for conveying the wet gas from the cells. Chemical porcelain towers are used for drying the chlorine gas in the presence of concentrated sulphuric acid before the chlorine is liquefied.

In the process industries where chlorine gas is present in conjunction with other chemicals in minute or large quantities, the universal chemical stability of porcelain is of great value. In a typical chlorination reaction, porcelain equipment can be used for conveying the individual chemicals entering the reaction, carrying out the reaction, handling off gases, waste products, and the finished product. It is apparent that the broad stability of chemical porcelain in the presence of wet chlorine, mineral acids, and chlorine compounds make it a versatile material of construction for the process industries.

Chemical porcelain equipment can be used over a wide range of temperatures—the limitation being that no sudden temperature changes exceeding approximately 100 deg. F. take place. For example, a pipe line may operate at 250 deg. F. provided it is not suddenly cooled to room temperature, or heated quickly from room temperature to the operating temperature of 250 deg. F. Any large temperature change should be made gradually.

Chemical porcelain equipment used in handling chlorine gas includes metallic flanged pipe, pipe fittings, plug cocks, angle valves, Y valves, safety valves, tower packings, and a great variety of special equipment.

FROM THE LOG OF EXPERIENCE

Dan Gutleben, ENGINEER

Hit's the syme the whole world over,
Plant chemists get all the blyme,
While consultants get the credick!
Hain't it all a blinkin' shyme?

Guest Conductor Henry Eckhardt takes over the Log this month with some fine recollections of his own bouts with the art and science of chemical engineering—as practiced at the "P.D.Q. Chemical Works." Mr. Eckhardt, when he sent us his entertaining and informative account, said he hoped it might stir the muse in some of the many readers who must be chock full of engineering anecdotes. To which this department adds a hearty second.

THIS WAS THE REFRAIN of a sad ballad entitled "The Lament of the P.D.Q." which I wrote for private circulation in the plant of the P.D.Q. Chemical Works, where I first learned that there was much more to chemical engineering than was found between the covers of textbooks. Of course, P.D.Q. is not the exact abbreviation; but out of consideration for the personal feelings of the corporation it is adequate.

The Old Man was the most even tempered man I ever knew. He was always mad! The other boys often told my successors that I was fired three times in one week. This was an exaggeration, since these events took place over a period of at least three months; moreover, while I may have been fired in the morning, in the afternoon I was always back at work in a remote corner of the plant keeping out of the Old Man's way. Always, that is, except at the end of my three year term. The penultimate time that I was fired was just after I had broken a ceramic pot for crystallizing potassium iodide.

BEFORE RUNNING the boiling hot solution of potassium iodide into the capsules, they were preheated carefully with live steam; nevertheless, ultimately they cracked anyway, and the costly solution of potassium iodide ran out on the earthen floor and was lost forever. My considered opinion was that the molecules of the pot just got tired; but the Old Man was of the opinion that we had been careless in preheating the capsules. In the end it was Bill Turner, then assistant professor of chemical engineering at Columbia University, who gave me the tip which saved me from further dismisssals due to fatigued ceramicware. He advised me that enameled cast iron bath tubs make excellent crystallizing dishes. These are available as seconds before the drain hole is bored. Minor blemishes in the finish are of no moment, and the enamel is resistant to the mild alkalinity of the potassium iodide solution. Besides requiring no preheating, they are better than ceramicware crystallizing dishes because they occupy less floor space, and they give up heat more rapidly, thereby speeding up production.

THE BIG HEADACHE was in the preparation of bismuth compounds. The trade demands light, fluffy bismuth preparations, but with the usual perversity of inanimate objects, the products often came out resembling white lead, except that they were not white—when they should have been. No matter how carefully every step of the recipe was followed, sometimes for weeks on end the product came out heavy and yellow, and lo, suddenly everything would be right again! The most annoying thing was that often, by pure coincidence, the process cleared itself up only after the Old Man had come in to straighten me out.

Obviously, the process was hexed, but I was handicapped by a scientific training and therefore considered this explanation inadequate. The production batches of bismuth subcarbonate were made with tap water. Now, since iron salts in alkaline solution precipitate the yellow hydrated iron oxide, it was elementary to deduce that the yellow tinge of the subcarbonate was due to iron. Now for the scientific method. Make a batch with distilled water and the point is proved. I did. That is, I made a laboratory batch using distilled water. The only trouble was that the point was disproved, since the product was worse than ever! It was about the densest bismuth subcarbonate ever made, and, after a few days around the laboratory, about the yellowest.

The experiment was a failure, but the problem was practically solved. Next a batch was made with distilled water fortified with calcium chloride, a sort of synthetically hardened water. The product was the lightest and whitest bismuth subcarbonate ever seen! The rest was easy. I had only to run a series of experiments, with an occassional glance at the periodic table for orientation, in order to find the most effective agent to make a fluffy product. Apparently small quantities of certain colloidial substances, when added at the right time during precipitation, had a marked effect on the crystalline growth and aggregation of bismuth subcarbonate.

BUT NOW for the bonus to the research! Bismuth subcarbonate was always known to be unstable in light, becoming light brown after several hours exposure to sunlight; but this new form of bismuth subcarbonate remained light-fast after an indefinite exposure to sunlight. Today I still have a problem: How can less than one-half percent of an additive agent screen off actinic rays as effectively as a lead blanket? If the chemical physicists can spare any time from atom splitting, I wish they would satisfy my curiosity.

WHAT HAD CONFUSED everyone at P. D. Q. for so long was that here the bismuth subcarbonate also turned brown due to exposure to iodine fumes wafted in from the adjoining iodine department. Three causes with apparently only one effect. Earlier, my predecessor, Jackson, had gotten himself out of this difficulty by merely citing an authority. All plant men are familar with the custom of rotation of furniture, how the oldest pieces wind up in the plant. At P. D. Q. this rule also extended to publications such as the United States Pharmacopoeia, which standard is published decennially. The current copy was in the Control Laboratory; the penultimate copy was on the Old Man's desk; and so on down to end-of-the-line Jackson, who took his recipes from a copy that had left the presses during the gas-light era.

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MAURICE A. KNIGHT
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the standard of puity for U. S. P. chemicals had risen steadily; in fact, today many U. S. P. products are of higher purity than the C. P. At any rate, on the day when the Old Man had Jackson on the carpet because the Control Laboratory reported the last lot of bismuth subcarbonate as being too heavy and having a yellow tinge, Jackson stormed off to his laboratory and returned to the Old Man with his aged, broken backed copy of the U. S. P. formulary. He slammed it on the desk and pointed to the relevant paragraph in the crumbling yellow page. "Bismuth subcarbonate, a heavy yellow powder. . .," and dammit, that's what I'm making!"

AN OLD PROVERB which I just coined declares "It's on ill color which colors the account books red." The yellow color developed by the reaction between iodine and bismuths gave P. D. Q. a lot of trouble; but it always paid off handsomely when P. D. Q. had a fire, which was more frequent than somewhat. In the part of the plant where the bismuth dissolving chambers were located, over a period of years the fumes of nitric oxides had given the interior of the wooden building a patina of what was essentially nitrocellulose. So one day the lead burner held his torch too close to the woodwork, and woosh, the whole room was smouldering! Everyone left the building at his convenience, and in a short time the firemen came and thoroughly doused the building.

The fire damage was slight, but the water damage was apparently tremendous. The bismuth salts on the upper floors had been flushed into the iodide department which was located on the ground floor. What had once been beautiful pure white crystals of potassium iodide, were now colored a poisonous orange-yellow. The claim adjuster could see that the product was ruined, but he forgot to put his trust in human nature—you can always trust it to take advantage of you! P. D. Q. claimed the potassium iodide was a total loss. So the insurance company settled accordingly, and let P. D. Q. dispose of the mess as best they could.

The best was to tell Old Stefan, who worked the iodide department, to add more than the usual quantity of *shtinkshtoff*. (Stefan understand no English and this was convenient plant German for the solution of ammonium polysulphide which was used regularly to remove heavy metals from potassium iodide solutions.) After processing the batch in the regular way, the Control Laboratory reported the lot to be better than usual.

Which just goes to show how profitable a little knowledge of chemistry can be.

NAMES IN THE NEWS

A. T. Bennett

C. A. Thomas

W. J. Sparks

Arthur T. Bennett has been elected a vice president of the Mathieson Alkali Works. His new title is vice president-general manager of operations.

William N. Porter was elected president of the Chemical Construction Corp. on January 1. Major-General Porter, former chief of Chemical Warfare Service, succeeded **Frederick Pope.** Colonel Pope retains his directorship on the board of the American Cyanamid Co.

Robert Cuthbertson Swain is now a vice president of the American Cyanamid Co. in charge of research and development following the retirement of **Milton C. Whitaker.** Dr. Whitaker continues as a Cyanamid director and technical adviser.

Morris E. Leeds, pioneer in the development of modern electrical instruments and in the field of industrial relations has received the highest honor of the American Society of Mechanical Engineers, the ASME Medal. The medal was presented at the society's annual banquet last month.

Clifford A. Hampel is now a member of the staff of Armour Research Foundation. He is inorganic chemist in the ceramics and minerals division.

Robert B. Bennett, formerly director of organic research for the American Brakeblok Division of the American Brakeshoe Co., has accepted the position of a group leader for the Firestone Chemical and Physical Research Laboratories of Akron, Ohio.

Charles A. Thomas, vice president and technical director of the Monsanto Chemical Co., St. Louis, and project director of the Monsanto-operated Clinton Laboratories at Oak Ridge, Tenn., has been elected president of the American Chemical Society for 1948. Dr. Thomas took office as president-elect of the Society on January 1, when **W. Albert Noyes, Jr.,** chairman of the chemistry department of the University of Rochester, became president succeeding **Bradley Dewey** of Cambridge, Mass.

M. R. Hatfield, chemist at the National Carbon Co., is now chairman of the Cleveland section of the American Chemical Society.

Marlin G. Geiger, former vice president of the Westvaco Chlorine Products Co. of Charleston, W. Va., became executive vice president of Davison Chemical Corp. on January 1. This is a newly created position. **Elmer B. Dunkak,** for the past 15 months in charge of all the corporation's engineering activities, has been promoted to the office of vice president. **G. Miller Hebbard** is vice president of Davison in charge of operations and **Charles E. Waring,** technical assistant to the president since 1945 has been promoted to the office of vice president for research and development.

Milton Harris, head of the research laboratories of Milton Harris Associates, Washington, D. C., has been elected chairman of the Division of Cellulose Chemistry of the American Chemical Society.

William J. Sparks, who has been actively associated with the development of a synthetic rubber, has been named director of the chemical division of the Esso Laboratories, Standard Oil Development Co. of Linden, N. J. Dr. Sparks replaces **Per K. Frolich,** who is now with Merck & Co.

Robert B. Semple has been appointed director of the general development department of Monsanto Chemical Co.

Bruce L. Calder, formerly chemical engineer with American Home Products Corp., is now project engineer with the Stauffer Chemical Co., Ardsley, N. Y.

S. Cottrell is now with American Potash & Chemical Corp. at their Los Angeles office. He is technical assistant to the executive vice president.

Hoyt M. Corley has been appointed assistant director of the chemical research and development department of Armour and Co., Chicago.

J. D. Yoder, D. J. Saunders, G. N. Proctor, and **H. L. Beohner** have been elected vice-presidents of the Permutit Co.

Samuel J. Kiehl, Jr., formerly associated with the Carbide and Carbon Chemicals Corp., Oak Ridge, Tenn., has joined the staff of Battelle Institute, Columbus, Ohio, where he will be engaged in research in organic chemistry.

Ernest S. Wilson, formerly chief engineer, is now director of the engineer-

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ing department of Hercules Powder Co. He succeeded **Luke H. Sperry** who retired December 31. **Ray N. Wheelock** was named assistant director.

Theodore A. Cook, manager of the Charleston, S. C., plant of West Virginia Pulp and Paper Co., has been elected to the board of directors of the company. Mr. Cook has been manager at Charleston since construction of the plant was begun in 1936 and has served with the company for 37 years. He was elected to the board to fill a vacancy created by the recent resignation of **Edwin S. Hooker.**

John M. Long has been appointed special assistant to the general manager of the paper makers chemical department of Hercules Powder Co. In his new position, Dr. Long will aid in the administrative work of the department. Since joining Hercules in 1933, he has worked on market development and technical liaison between Hercules and its customers.

B. P. Mulcahy, for the past 11 years research engineer for the Citizens Gas and Coke Utility of Indianapolis has announced the opening of his own offices in Indianapolis as engineering consultant on cupola operation and coal carbonization.

Abner B. Wellborn has been appointed superintendent of the metallurgy division of the General Electric chemical department, Pittsfield, Mass.

Arthur A. Regel, formerly associated with the United States Rubber Co. as engineer in the plastic-insulation department, has joined Harte & Co. Inc., as chief chemist in charge of laboratory research in the division of plastic fabrics and sheetings.

George Batchelder has been appointed to fill the post of technical director of the F. G. Findley Co. Prior to joining the Findley Co., Dr. Batchelder was associated with the eastern laboratory of E. I. du Pont de Nemours & Co.

W. H. Abernethy, formerly research chemist with Goodyear Tire and Rubber Co., has joined the staff of Southern Research Institute.

V. A. Shiple has retired as chief chemist of the National Milling Co. **Joseph Zvanevec** has been named chief chemist for the company to fill the place left vacant by Mr. Shiple's retirement.

J. H. Walthal and **Philip Miller**, two chemical engineers from the TVA, won the William H. Walker award of the American Institute of Chemical Engineers for the report on their de-

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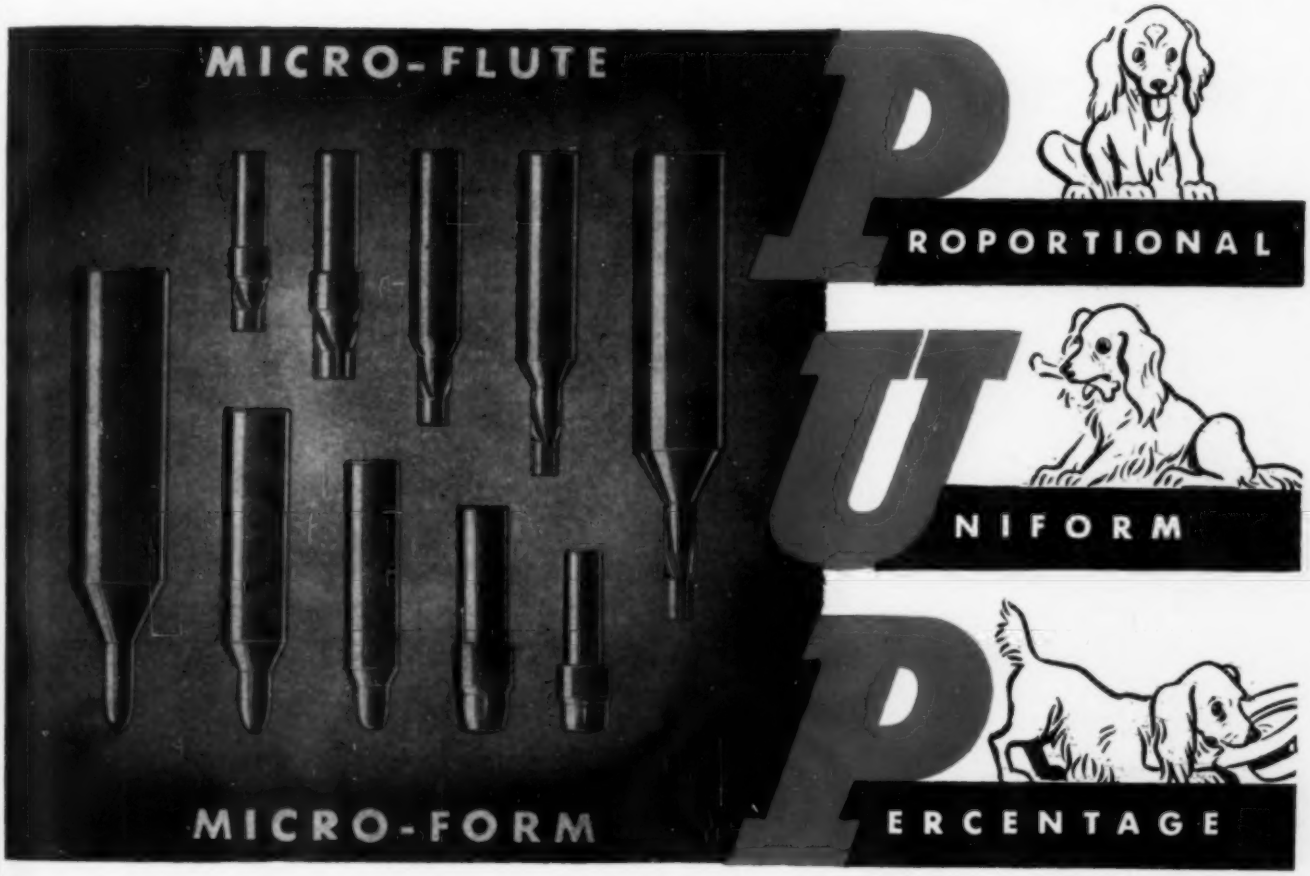

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velopment of a sulphuric acid process for making alumina from clay. The award was presented during a banquet held last month at Atlantic City, where the chemical engineers held their thirty-ninth annual meeting. **Charles E. Lapple**, chemical engineer with E. I. du Pont de Nemours & Co., won the Junior Award for his work and publication on the flow of compressible fluids.

William N. Lacey has been selected by the board of directors of the American Institute of Mining and Metallurgical Engineers to receive the Anthony F. Lucas Gold Medal for 1947. The Medal was established in 1936 to be awarded from time to time in recognition of distinguished achievement in improving the technique and practice of finding and producing petroleum.

A. C. Foster has been appointed to the position of chief engineer of Standard Brands.

•

Carl F. Graham, research analytical supervisor of the Wyandotte Chemicals Corp., Wyandotte, Mich., is chairman of the Detroit Section of the American Chemical Society. He took office on January 1, succeeding **Everett L. Henderson** of the department of chemistry of the University of Detroit. **Charles K. Hunt,** applied research superintendent of Sharples Chemicals, Inc., is chairman elect.

Frank M. Clark, insulation expert at the Pittsfield works of the General Electric Co.'s apparatus department and assistant engineer of the works laboratory, has been named technical consultant on insulation of the entire apparatus department.

Garth L. Putnam has recently accepted a position as associate professor on the staff of the Chemical and Metallurgical Engineering Department at Oregon State College. Dr. Putnam was formerly research engineer for the Carborundum Co.

T. L. Swenson has been relieved as director of the Western Regional Laboratory of the U. S. Bureau of Agricultural and Industrial Chemistry. He will be a special assistant to the chief of the bureau dealing with certain food industry problems. **Michael J. Copley** who has been head of the division of analytical and physicochemical research at the Eastern Laboratory succeeds Dr. Swenson in California.

H. E. Roche has been named manager of the production department of the chemical division of the Koppers Co.; **T. C. Keeling,** manager, sales department; **D. E. Meagley,** manager, con-

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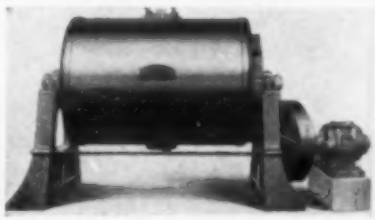

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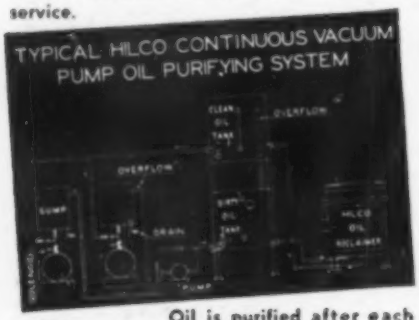

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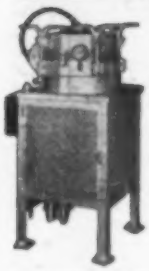

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trol section and assistant to the vice president; **P. L. Griffiths**, manager, personnel department; **W. F. Alexander**, division purchasing agent; **Ralph Hein**, manager, finance department and **C. F. Winans**, technical adviser. **A. A. Sellers** has been appointed manager of the Koppers chemical plant at Kobuta, Pa.; **S. C. Whitehouse** is assistant manager; and **H. M. Hartong** is chief chemist.

E. I. Valko is now director of research of E. F. Drew & Co., Inc.

James C. Shore, Robert E. Wright, Fritz Kobayashi and **Dorothy V. Reinhard** are recent additions to the staff of Milton Harris Associates.

R. Wade Collier, chemical engineer, has joined the staff of Southern Research Institute.

OBITUARIES

Charles D. Young, 58, sales manager of the Metal & Thermit Corp., died at the Orange (N. J.) Memorial Hospital on November 16.

David FitzGerald, 51, manager of employee relations for the Plastics Divisions of the General Electric Co., died at his home in Pittsfield, Mass., November 28.

Charles N. Forrest, 70, of Cranford, N. J., a retired chemical engineer, died in Fort Myers, Fla., December 2.

Harry A. Trautman, founder and head of Trautman Chemical Engineering Co., East Cleveland, Ohio, died in Cleveland December 4.

E. H. Jeffords, 71, recent director of Raybestos-Manhattan, Inc., and general manager of General Asbestos & Rubber Division, North Charleston, S. C., died at his home in Charleston, December 12.

Charles B. Thwing, 87, pioneer in the field of pyrometry and president of the Thwing-Albert Instrument Co., Philadelphia, died December 12.

George W. McKay, 47, president of Dean and Barry Co., paint manufacturers, Columbus, Ohio, died December 17.

J. Lea Fearing, Jr., 45, manager of the Allentown, Pa., office of the St. Regis Sales Corp., died in White Plains, N. Y., on December 17.

Robert J. Moore, 54, plastics authority and technical coordinator of the Bakelite Corp., died at his home in Montclair, N. J., January 6.

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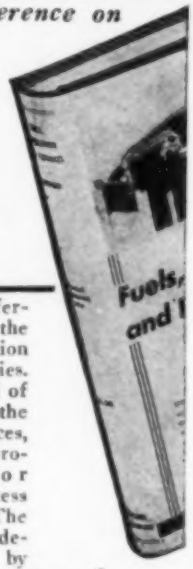

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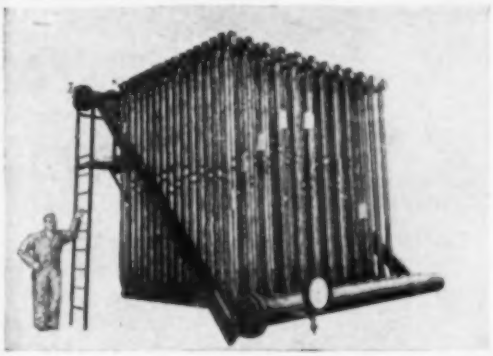

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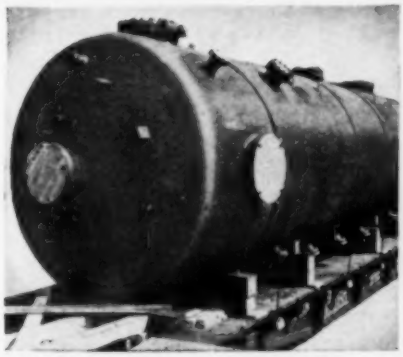

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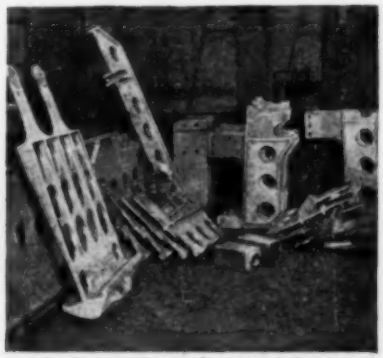

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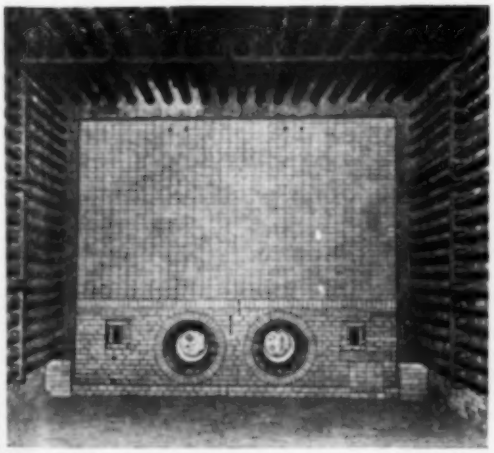

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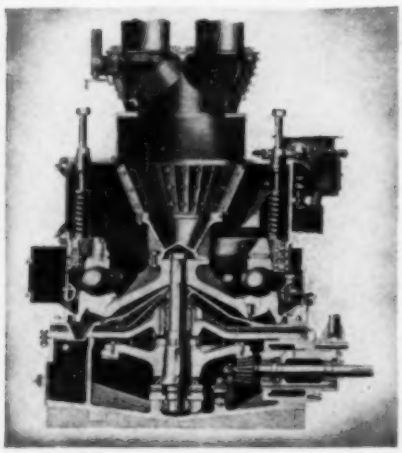

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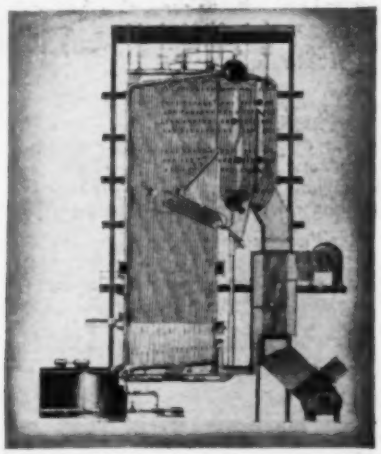

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INDUSTRIAL NOTES

Tennessee Products Corp., Chemicals Division, Nashville, has moved its New York sales headquarters to the Empire State Bldg. Eugene F. Allen is in charge of the new office.

Niagara Filter Corp., Buffalo, has appointed Jose M. Cabrera of Mexico City as its sales engineering representative in Mexico.

Arcos Corp., Philadelphia, has completed a new laboratory building adjoining its plant. The research and engineering department moved into this new building at 50th and Paschall Ave. in December.

Hewitt-Robins, Inc., has combined the Chicago offices of Robins Conveyor Division and Hewitt Rubber Division at 7 So. Dearborn St.

Rohm & Haas Co., Philadelphia, has acquired about 500 acres on the Houston Ship Channel, Deer Park, Tex., for use as a plant site. Construction of the plant is expected to begin early this year.

Diamond Alkali Co., Pittsburgh, has acquired the assets of Benner Chemical Co., Chicago, which will now function as Diamond Alkali Co., Benner Chemical Sales Division. The new division is in the charge of C. W. Klaus and E. J. Mills.

Continental Can Co., New York, has elected Hans A. Eggerss president of the company. Carle C. Conway who has been acting as chairman of the board and as president, will remain as chairman of the board.

Ampco Metal, Inc., Milwaukee, has appointed Oscar Frohman as general sales engineer. Frohman has been manager of market development and will continue to carry out such work as is necessary in that capacity. James Arter has been promoted to the position of Assistant to the General Manager.

Lincoln Electric Co., Cleveland, Ohio, has made G. S. Parsons a dealer in the company's equipment in San Diego, Calif. Mr. Parsons has been affiliated with the company for nearly 14 years.

Carrier Corp., Syracuse, N. Y., has made Alfred E. Stacey, Jr., process consultant to the sales division. Mr.

Help for your
CHEMICAL STORAGE and PROCESSING PROBLEMS •

STAINLESS STEEL STOCK POTS

• Solve many of your storage and processing problems with these rust-proof, acid-resisting, easy-to-clean Stock Pots.

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This arrangement of pipes and valves is known in the oil and gas industry as a "Christmas tree." The "Christmas tree" is at the head of the well and controls the flow of oil and gas as it comes out of the ground.

There's a close connection between "Christmas trees" and the Nor'way* Anti-Freeze that is keeping countless automobile radiators from freezing this winter. For Nor'way is produced from methanol which Commercial Solvents makes by processing natural gas.

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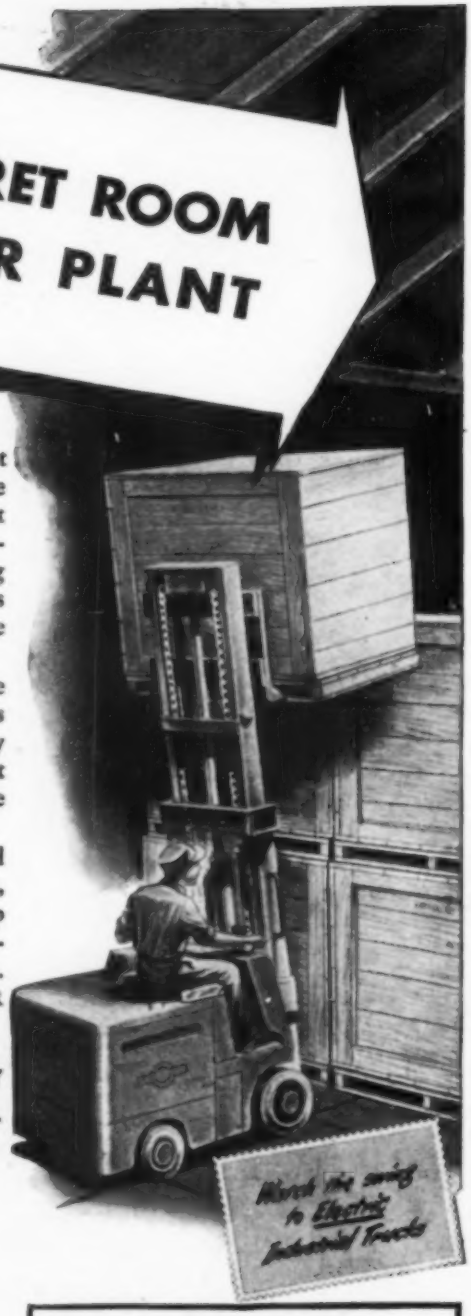

IT'S THERE — probably right where you need it most—more room for materials. Part of it may be right beside your machines. Part of it is on the loading platform where space is always at a premium. Part of it will be in your warehouse.

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- Minimum maintenance costs.

This is the truck to take loads off your mind.

Stacey is one of the seven founders of the corporation, he recently returned from active duty with the Navy as a captain.

Minneapolis - Honeywell Regulator Co., has opened a new branch office for the Brown Instrument Div. at 117 W. Eighth St., Tulsa, Okla. The new office is in the charge of R. P. Walker.

E. B. Badger & Sons Co., New York, has reestablished offices of E. B. Badger & Sons (Great Britain) Ltd. in London. The company has also announced the formation of Badger Servicos Technicos de Engenharia S. A. with offices in Rio de Janeiro. Fluor-Lewis & Co. has been named as Badgers' western representative with offices in the Petroleum Bldg., Los Angeles.

Gardner-Denver Co., Quincy, Ill., has appointed G. V. Leece to the position of general sales manager. He was formerly vice president in charge of the export division with offices in New York.

International Minerals & Chemical Corp., Chicago, has named D. A. Pfaelzer assistant sales manager of the Amino Products Division.

Radio Corp. of America, Camden, N. J., has made the Eriez Mfg. Co., Erie Pa., exclusive distributors for the company's electronic metal detector in the New England States, New York, New Jersey, Delaware, Maryland, and most of Pennsylvania.

Hardinge Co., Inc., York, Pa., has moved its San Francisco branch to Room 24, 94 Natoma St.

H. K. Porter Co., Inc., Pittsburgh, has elected C. R. Dobson as vice president in charge of operation.

Bonney Forge & Tool Works, Allentown, Pa., has made Charles D. Otterson sales manager.

Ortho Pharmaceutical Corp., Somerville, N. J., has completed its new million dollar Research Institute. Dr. C. E. Folsome is head of the research division which occupies the new institute.

Armstrong Cork Co., Lancaster, Pa., has named J. E. Gaston to the position of manager of building materials research.

American Brake Shoe Co., American Manganese Steel Division, Chicago Heights, Ill., has named A. R. Sittig manager of manganese steel sales. E. L.

ANOTHER

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This Edge Moor horizontal autoclave with quick-opening door is *another* Edge Moor achievement in process equipment fabrication . . . a direct result of Edge Moor experience, facilities and proficiency.

Edge Moor is equipped to furnish *any type* of heavy-wall welded fabrication to your individual designs, specifications or requirements. Materials include:

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Edge Moor Shops have complete facilities for stress-relieving, annealing and X-ray . . . and are approved by leading insurance companies for fusion welding to meet all codes and tests. We shall be pleased to place our experience and facilities at your disposal when you are considering additional plant equipment. Write for literature *today*.

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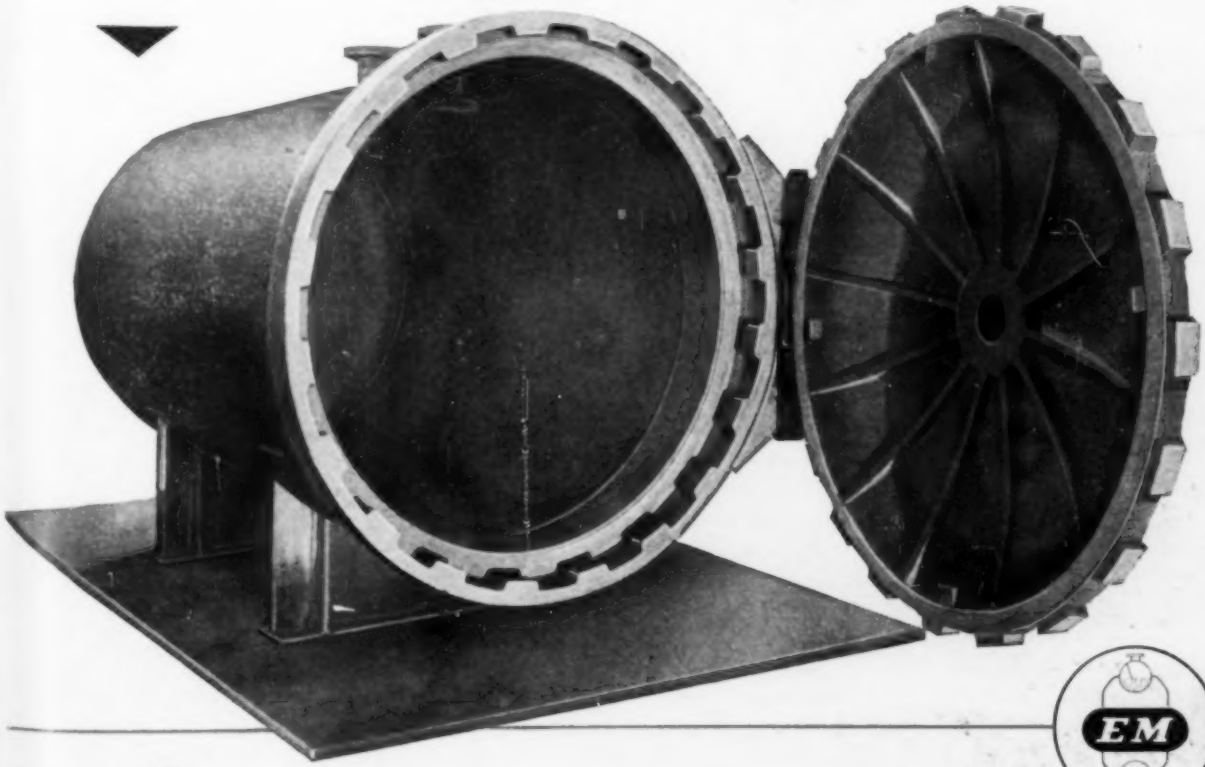

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Positive AUTOMATIC PROTECTION

Tramp iron damage to processing equipment and possible contamination of finished products is eliminated positively and permanently with Dings "High Intensity" Magnetic Pulleys on the job.

Wherever materials in process are handled on conveyor belts, Dings Pulleys, installed as drive pulleys at the head of belts, remove tramp iron *automatically* at all normal belt speeds and loads.

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As tramp iron in material on belt approaches Dings Pulley, powerful magnetic field holds it to the belt surface until it passes underneath the pulley and out of the magnetic field, where it is discharged automatically. Cleaned material passes over pulley in a normal trajectory.

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"Separation Headquarters Since 1899"

PROTECTION • SEPARATION • CONCENTRATION • PURIFICATION

Quinn is assistant vice president in charge of welding products. E. J. Mist has been made assistant vice president with offices at 230 Park Ave., New York.

Vapor Recovery Systems Co., Los Angeles, has opened a direct factory sales and engineering office at 1501 Euclid Ave., Cleveland. T. L. Reilbing is district manager.

Turco Products, Inc., Los Angeles, has made L. H. Moulton national sales director. D. T. Buist has been named assistant national sales director. They will make their headquarters in the firm's main office.

Monsanto Chemical Co., Plastics Division, Springfield, Mass., has opened a Cincinnati sales office. Edward T. McBride is the branch manager. The sales territory will embrace parts of Ohio, Indiana, Kentucky, Tennessee, Pennsylvania and all of West Virginia.

Hungerford Plastics Corp., Murray Hill, N. J., has elected R. M. Ellis to the post of vice president.

Comstock, Duffes & Co., Buffalo, N. Y., is the new name of the former Addison Vars Co. It will be under the direction of its partners, Henry W. Comstock, H. Earl Close, Kenneth S. Duffes, and Frank J. Hess.

Pennsylvania Salt Mfg. Co., Philadelphia, has elected Charles B. Grace to the Board of Directors. He is also vice president and treasurer of the Heintz Mfg. Co., Philadelphia.

Indar Corp., Indianapolis, Ind., has completed its engineering work on complete facilities for producing powder metallurgical parts for ferrous and non-ferrous materials. The new facilities include powder mixing, pressing and sintering.

Colorado Fuel & Iron Corp., New York, has elected A. F. Franz of Pueblo, Colo., as vice president in charge of operations of Wickwire Spencer Steel.

Lebanon Steel Foundry, Lebanon, Pa., has appointed Lee G. Miller, plant manager for all of its operations in the home plant.

St. Regis Paper Co., New York, has elected the following officers: Mason F. Ford, executive vice president and South American manager; Thomas H. Cosford, executive vice president and Canadian manager; Reginald L. Vayo, executive vice president and director of sales of Kraft Pulp; and William H.

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- ★ CORROSION-PROOF LININGS
- ★ STREAMLINED FLOW

GRINNELL-SAUNDERS DIAPHRAGM VALVES

● The flexible diaphragm isolates the working parts of the valve from the fluid, preventing contamination, and permits streamlined flow plus positive closure even with suspended solids.

A selection of diaphragm materials and also body linings of glass, porcelain, lead, rubber or synthetics protects against corrosion.

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If Industrial Pumps are one of your responsibilities, ask now, for free copy of this authoritative, unbiased analysis of Industrial Pumps. It is a timely presentation of pump facts.

This is the first analysis, insofar as we know, to prevent the misapplication of Industrial Pumps. It is written by one who has a rather wide and diversified knowledge of many types of pumps. But the author holds no more of a brief for any one type than its adaptability warrants.

He endeavors to explain the limitations of various types of pumps such as piston, plunger, rotary and centrifugal. Thus he attempts to prevent, as much as possible, misapplication.

Based also on the long experience of Taber Pump Co., this modest contribution is offered to users of pumps in the processing industries. We will gladly send a copy of this bulletin No. S-146, when it is requested on business stationery.

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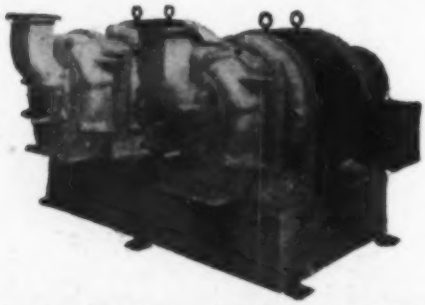

This exceptionally sturdy, ruggedly constructed mill grinds material to finished size. Built-in cooling device. Cooling-liquid is continuously circulated against the back of each grinder disc. Robinson Processing Equipment of every type . . . Crushers, Grinders, Sifters, Attrition Mills . . . is designed to your requirements by experienced engineers. Literature available. Inquiries invited!

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Anders, executive vice president and manager of the Nashua River Division; Edgar Hoppe, vice president and European manager; Burton A. Ford, vice president, Multiwall Bag Division; and C. A. Brothman, comptroller.

Fritzsche Brothers, Inc., New York, has opened a new branch office at 1514 Dime Building, Detroit, Mich. The new office will be under the supervision of T. Fred Baker.

Threadwell Tap & Die Co., Greenfield, Mass., has appointed Paul W. Polk vice president and manager.

Lukens Steel Co., Coatesville, Pa., has appointed Harry A. Dennis as assistant district manager of sales in the Chicago office.

Link-Belt Co., Chicago, has opened a sales office in Milwaukee. William M. Hufnagel, district sales manager, is in charge of the new office, assisted by H. B. Johnson and F. E. Sweeney.

Charles S. Jacobowitz Co., Buffalo, N. Y., has appointed Carl F. Quellos to the post of plant superintendent.

Reeves Pulley Co., Columbus, Ind., has opened a new Philadelphia office in the Wilford Bldg., 33rd and Arch Sts. Philip C. Talbot is manager.

N. I. Malmstrom & Co. has opened a new office and warehouse at 30 W. Washington St., Chicago.

Nordberg Mfg. Co., Milwaukee, has named Arthur G. Hall works manager. B. T. Eagerton has been named export manager. He will be located in the main office at Milwaukee.

Plant Rubber & Asbestos Works, San Francisco, has made J. C. Voiles division manager for the entire East and Midwest territories, his headquarters are at 295 Fifth Ave., New York.

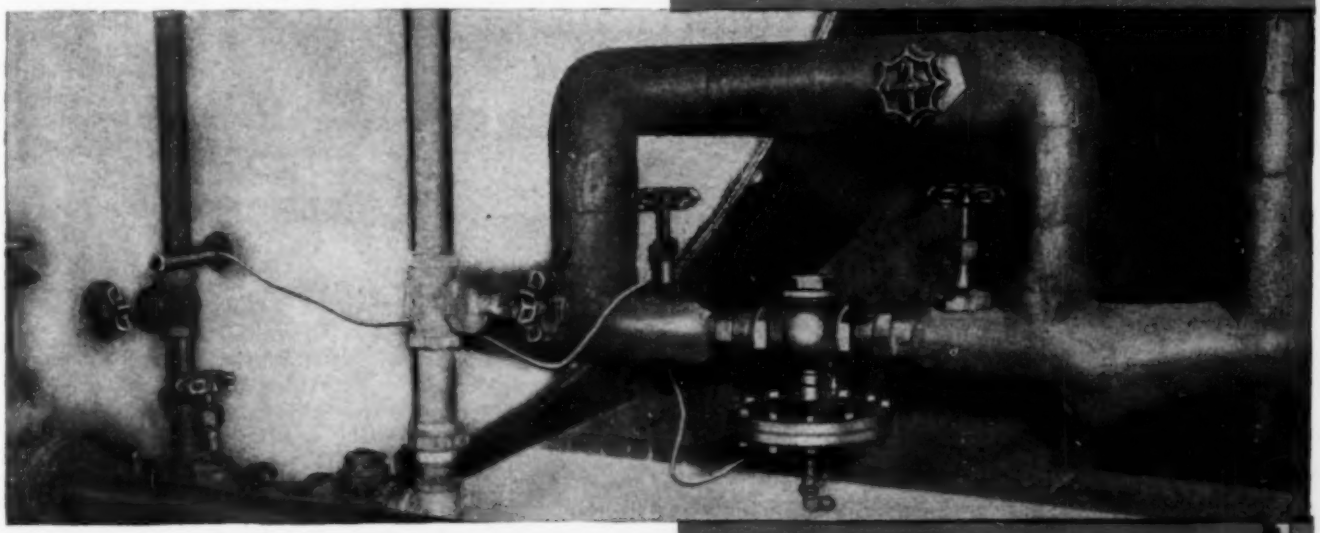
Niagara Filter Corp., Buffalo, N. Y., has named Louis D. Arroyo export manager. He will make his headquarters in the home office.

Blackmer Pump Co., Grand Rapids, Mich., has named John B. Caldwell chief engineer and L. R. DeWolf and V. A. Brunson senior engineers.

American Cyanamid Co., New York, reports that its Canadian subsidiary, North American Cyanamid Limited, has concluded an agreement with the Canadian Government to acquire the war-built Welland Chemcial Works, located on the Welland River near Port Robinson, Ontario.

Making Oil Run

AT ZERO TEMPERATURES



Outdoor blending tanks lead directly to processing rooms in this Pittsburgh plant which makes highly special lubricating greases. "Temperature is one thing we have never worried about since we began installing Sarco 2430 Regulators two years ago," says the Mechanical Superintendent. It's another case where too much heat would ruin the product —too little would shut down the plant.

This regulator is also frequently used on hot water storage tanks—as shown at the right.

Other forms of Sarco Controls are available for steam equipment in process work, air in rooms or ducts, cooling of jackets and condensers, and the blending of hot and cold water, brine or other liquids.

The correct combination of Sarco Steam Traps and temperature controls can be determined by the nearest Sarco Representative—a specialist in industrial and heating applications.

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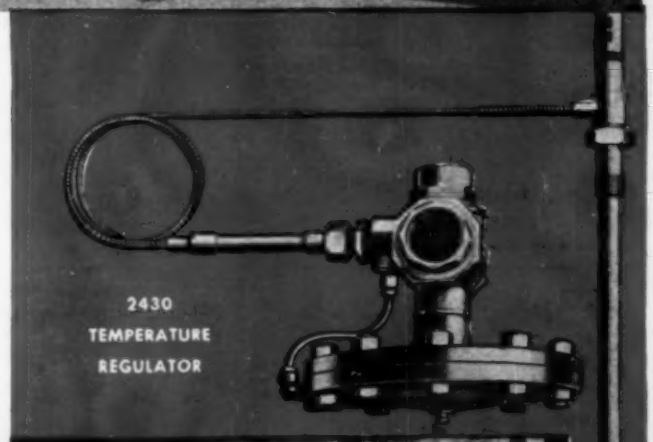
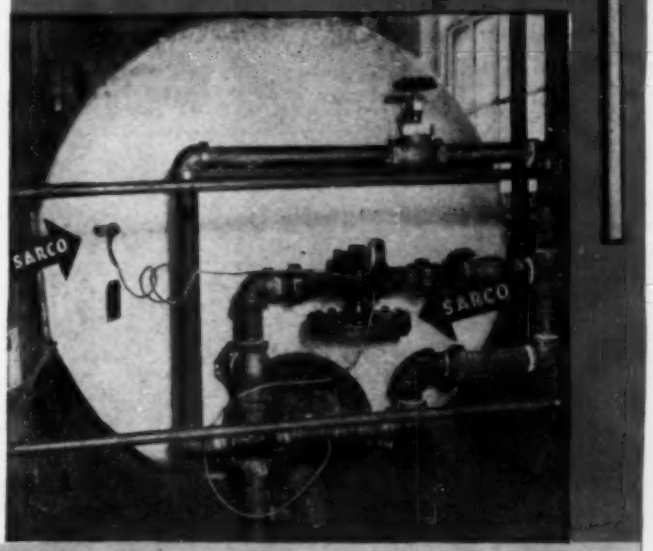


2430
TEMPERATURE
REGULATOR



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Lektromesh is metal screen made by electro-deposition .. a one-piece solid metal product with no woven structure to ravel. It is stiff, tough, and strong; in filters, strainers and other uses for industrial wire mesh it supplements woven mesh and is most applicable in the finer sizes beyond the limits of perforated metal. Lektromesh combines high accuracy of hole dimensions with a smooth surface, and is readily fabricated by drawing, stamping, welding, soldering or other processes. In sizes 40 to 400 mesh .. in standard rolls or fabricated into parts to your specification.

We will be pleased to send you samples of LEKTROMESH for your further consideration.

THE C. O. JELLIFF MFG. CORP.
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CONVENTION PAPER ABSTRACTS

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CHEMICAL HAZARDS OF URANIUM HANDLING

CHEMICAL hazards are present in certain phases of the production of nuclear energy. Although uranium is a weakly radioactive substance (alpha emitter), this particular property as such is of no practical importance as a radiation hazard per se in comparison with its chemical toxicity. Its detection in body excreta accordingly generally depends upon its chemical rather than upon its radioactive properties. One of the first problems of the health groups was to develop a reliable quantitative method for its detection in very small amounts. A method was developed which enables one to measure accurately one part in 10,000,000 in animal tissue, blood or urine. Its presence can be detected in much smaller amounts, 1/2,000,000,000 of a gram.

To a certain degree, though not entirely, the toxicity of uranium varies with the solubility of the compounds. The various compounds may be encountered in the form of particulate dusts or gases. Protection against chemically toxic dusts and gases is an old problem to industrial engineers, toxicologists, and industrial hygienists. Protection consists in completely closed systems where possible, adequate circulation systems to evacuate the deleterious agents from the atmosphere, gas masks, and special procedures for laundering the work clothing of plant personnel. Personnel hygiene and rigid medical supervision to detect small amounts of noxious substances in he excreta of the personnel are important features of adequate health protection Such a program requires many industrial physicians conversant with the

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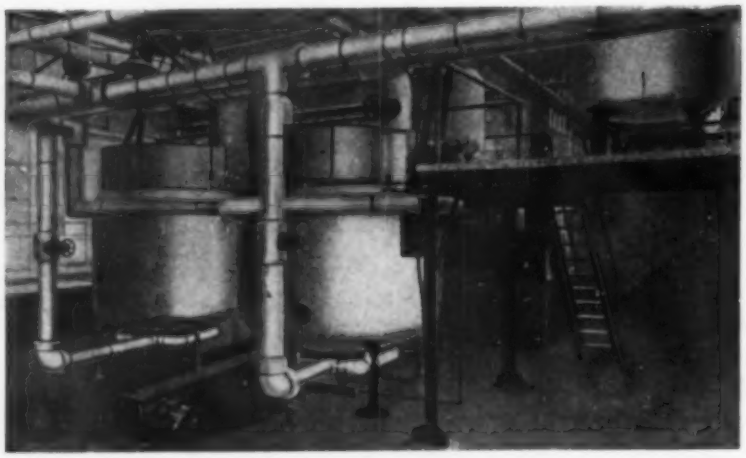

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clinical abnormalities likely to result from undue exposure to the chemical involved. The production of the atomic bomb and the peacetime utilization of nuclear energy and its products has and will require the utmost in cooperation among industry, industrial hygienists, radiobiologists, toxicologists, and scientists in general.

The toxicology of uranium and its various compounds has been the subject of a very thorough and careful investigation. It is doubtful that any other industrially hazardous chemical has had a comparable investigation. Certainly not in so few brief years. The results of these studies carried on by the several medical groups are being assembled for publication. It is sufficient to state at this time that many of the uranium compounds may be absorbed into the body through the skin, by way of the lungs, or from the gastro-intestinal tract by ingestion. Uranium per se is primarily a nephrotoxic substance and is principally excreted through the kidneys.

Andrew H. Dowdy, The University of Rochester, before The American Public Health Association, Cleveland, Nov. 13, 1946.

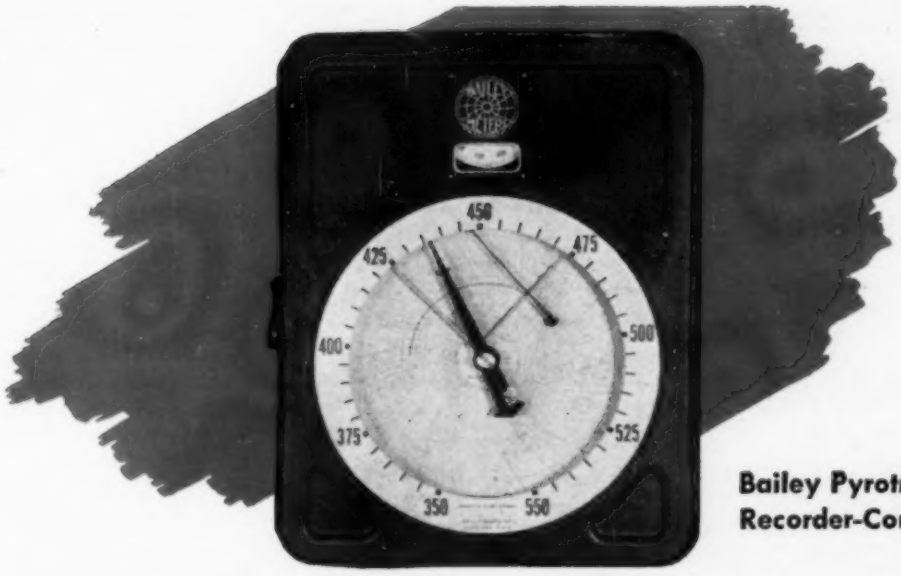
NEW PROCESS FOR WOOD DISTILLATION

WITHIN the last two decades, charcoal plants, which are dependent on a market for wood distillation products, have been steadily closing down since synthetic processes have been developed for making these chemicals. The charcoal plants could not meet the keen competition of the plants producing the distillation products synthetically. On the other hand, no one has been able to produce synthetic wood charcoal so a few plants still meet the steady domestic and industrial demands for the product.

A new process not only may put the remaining producers on their feet but also may result in additional distillation plants.

In contrast to the old fashioned plants in which wood is loaded by hand into cast iron trains or "buggies" and placed in heated kilns, the process uses a steel chamber or retort into which the wood is charged at the top and continuously emerges as charcoal at the bottom. The flue combustion gases are circulated several times in the retort thus drying the wood and saving on the amount of heat necessary for carbonization.

Other advantages of the process are a lower investment and a higher recovery of superior quality products. One ton of dry wood yields 1,000 lb. of charcoal, 125 lb. of acetic acid and 80 lb. of methanol. In comparison, the oven processes now in use yield



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R. S. Aries, Polytechnic Institute of Brooklyn, before Northeastern Wood Utilization Council, Boston, Dec. 12, 1946.

NUCLEAR NOTES

SCIENCE can no more predict the results of the atomic energy development than it could foresee, in Benjamin Franklin's time, the full significance of electricity. Knowledge of nuclear forces at present is inadequate to correlate the simple experimental facts available into a unified theory. Even the data already obtained by the use of radioactive tracer substances may have to be revised, because to a great extent the materials employed had radioactive powers much lower than those of by-products for uranium piles. Further research may lead to the use of other and more common elements as fuels.

Atomic energy has created a new problem with regard to the continuation of physical investigation, although not a problem in physics itself. The nuclear research program sponsored by the government during the war demonstrated that an exhaustive program in nuclear physics is beyond the facilities of any existing university. This is true particularly of finances, but also of existing arrangements for cooperation between men working in the necessary allied fields.

It is still possible for a school to sponsor research of the highest grade in certain fields of nuclear physics, but these fields are becoming fewer as the larger machines develop better ways of getting the same answers. The only disinterested body with enough money to finance an elaborate program in nuclear physics is the national government and we may expect it is to play an ever-increasing role in this field.

Robert N. Little, University of Texas, before regional meeting of American Chemical Society, Dallas, Dec. 13, 1946.

PREVENTIVE INDUSTRIAL MEDICINE

INDUSTRIAL medicine is vaguely understood yet, but it will become more widely adopted. About 40 years ago there were around 25 physicians in industrial medical work; today they number about 5,000. This branch of medicine must constantly keep in mind an objective: to maintain a balance between the worker's health and his environment to the end that they are compatible.

Early industrial medical practice was merely to treat the injured. The early practitioners had no constructive program to offer industry, and little or no interest in the less obvious, less dra-

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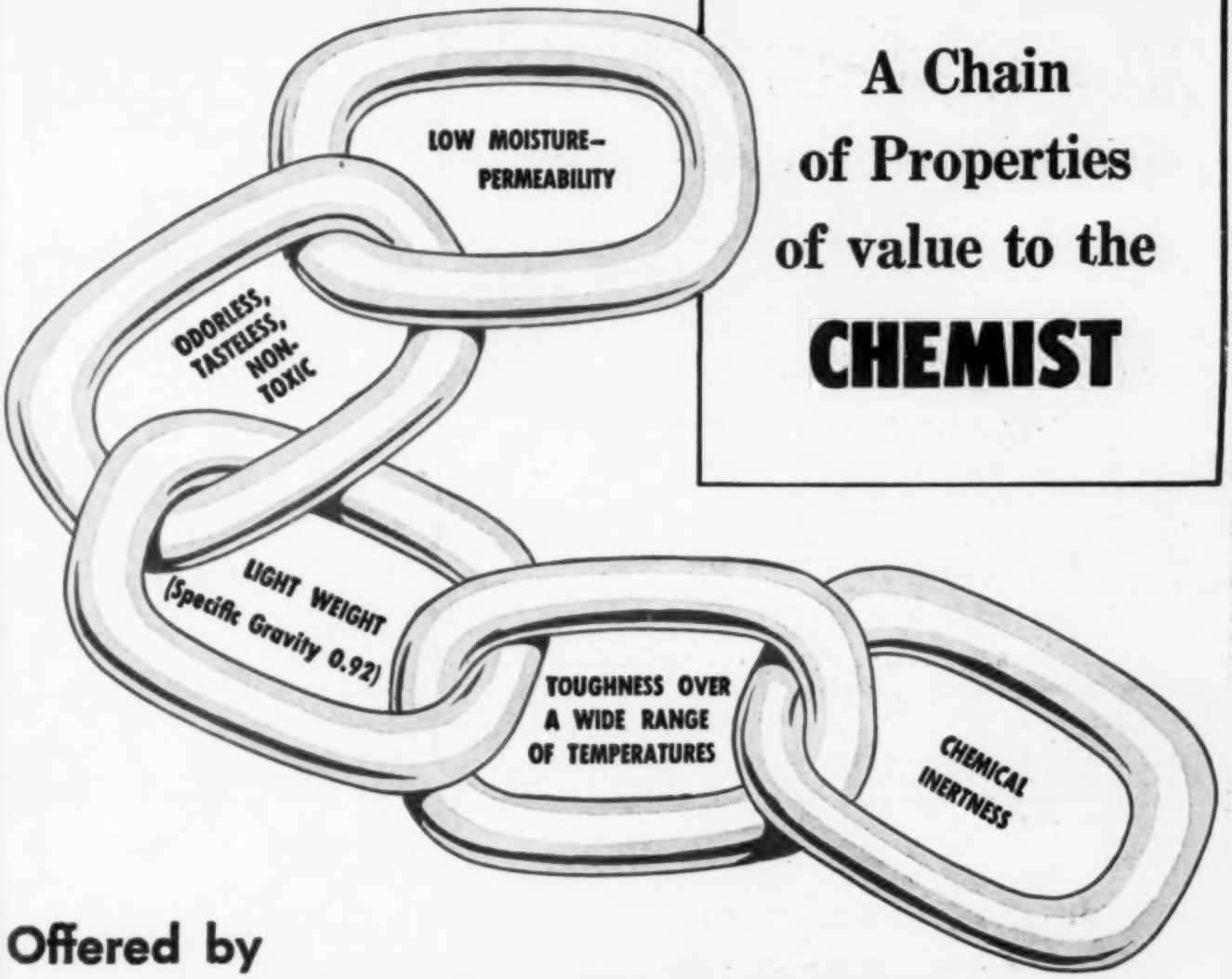

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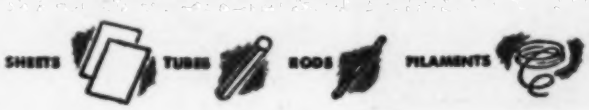

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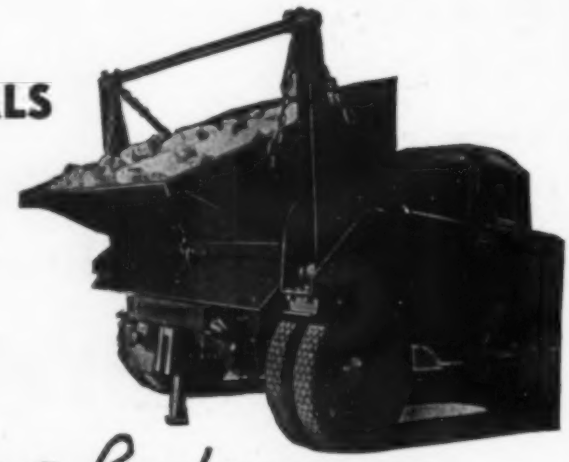

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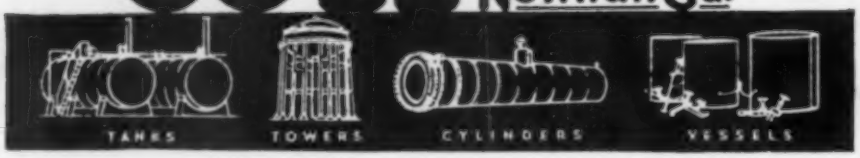

matic industrial ills, such as tuberculosis. They had little concern with causes of injuries and bad health. This situation finally improved to the point where industrial hygiene began to receive attention. Today, the objective is to keep the health of workers at the highest level. The industrial practitioner has to arrange for the best medical treatment furnished either by himself or by qualified specialists outside the plant.

The modern industrial medical man has a variety of tasks. These include preemployment examinations to determine whether prospective employees are capable of handling a particular job, periodic examinations, special examinations when they are indicated, arrangement for visiting nurse service, making inspection trips in the plant to determine the nature of working conditions, contacts with the family physicians of workers, and performance of job termination examinations.

S. L. Rankin, M.D., E. I. du Pont de Nemours & Co., before 1946 Fall Safety and Fire Conference, Washington, D. C., Nov. 15, 1946.

STYRENE COPOLYMER SOLVENT REACTING VARNISHES

Fosterite resins are a series of compounds having widely varying properties and compositions. Fosterite M 8689-1 is a solvent reactive varnish or resin of low viscosity used as a coil impregnant. M 8690-2 is a high-viscosity mica-filled resin used for surface-coating applications. Although either material may be used alone, a combination of the two is often desirable.

Fosterite resins are relatively easy to make from inexpensive and commercially available raw materials. M 8689-1 resin is prepared by reacting castor oil with maleic anhydride. Castor oil hydroxyl groups are reacted with the theoretical amount of maleic anhydride to form a half-ester of the anhydride. The product is miscible in all proportions with styrene which, for this particular resin, is added in the ratio of 35 parts styrene to 65 parts of the base resin. Quinhydrone is used to stabilize the resin and benzoyl peroxide is added before use to catalyze the polymerization. Upon heating the solution, polymerization occurs through the double bonds of the maleic groups and the ethylenic double-bonds of the styrene. Since the castor oil maleate molecules are trifunctional, a cross-linked thermoset copolymer results.

Castor oil maleate has a molecular weight of approximately 1,227. The molecule is of about the right size to give a varnish of low enough viscosity (85 centistokes at 25 deg. C.) so that it penetrates well without being so fluid that excessive "run-out" occurs.

If higher viscosities should be de-

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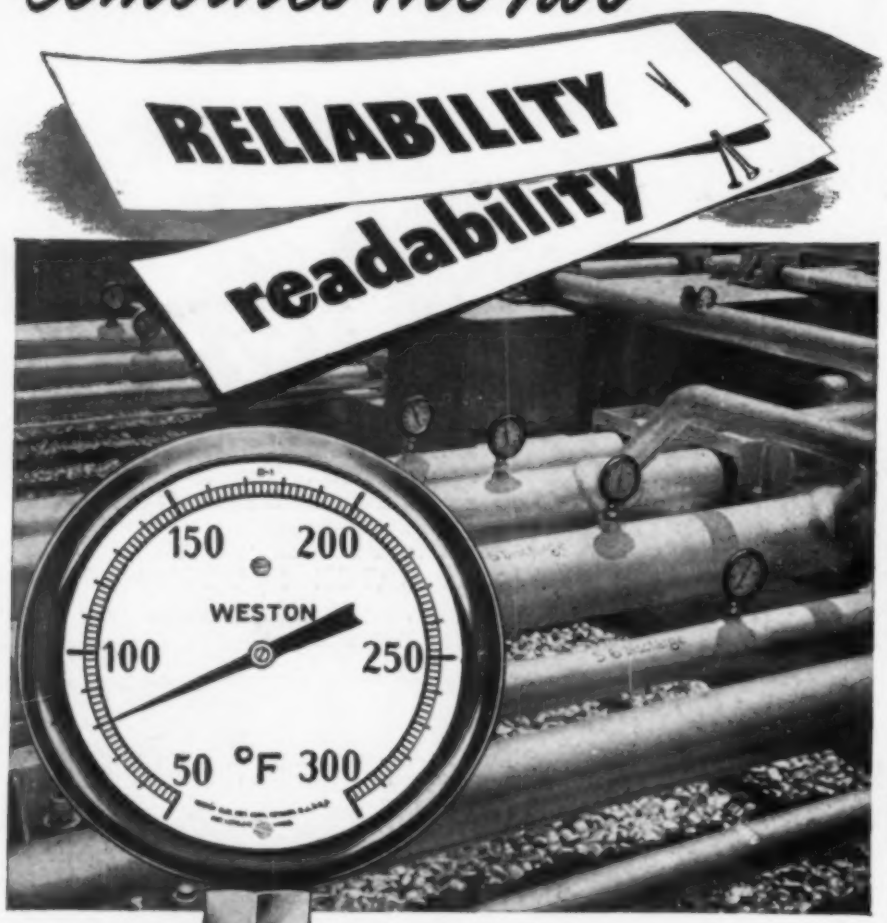

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sired, these are obtainable by polymerizing the resin with styrene under conditions that prevent cross-linking of the linear chains with resultant gel formation. Thermoplastic resins of high viscosity containing as much as 60 percent styrene have been prepared. These can be dissolved in more styrene and further polymerized under ordinary conditions to give thermoset solids. They show good promise as casting resins. As the further polymerization necessary to cross-link them is small, the shrinkage is low.

Other variations of the basic M 8689-1 resin can be made by reacting less maleic anhydride with the castor oil. When polymerized, these less highly cross-linked resins are thermoset but are elastomeric.

The M 8689-1 resin can be cast to give transparent straw-colored blocks or sheets.

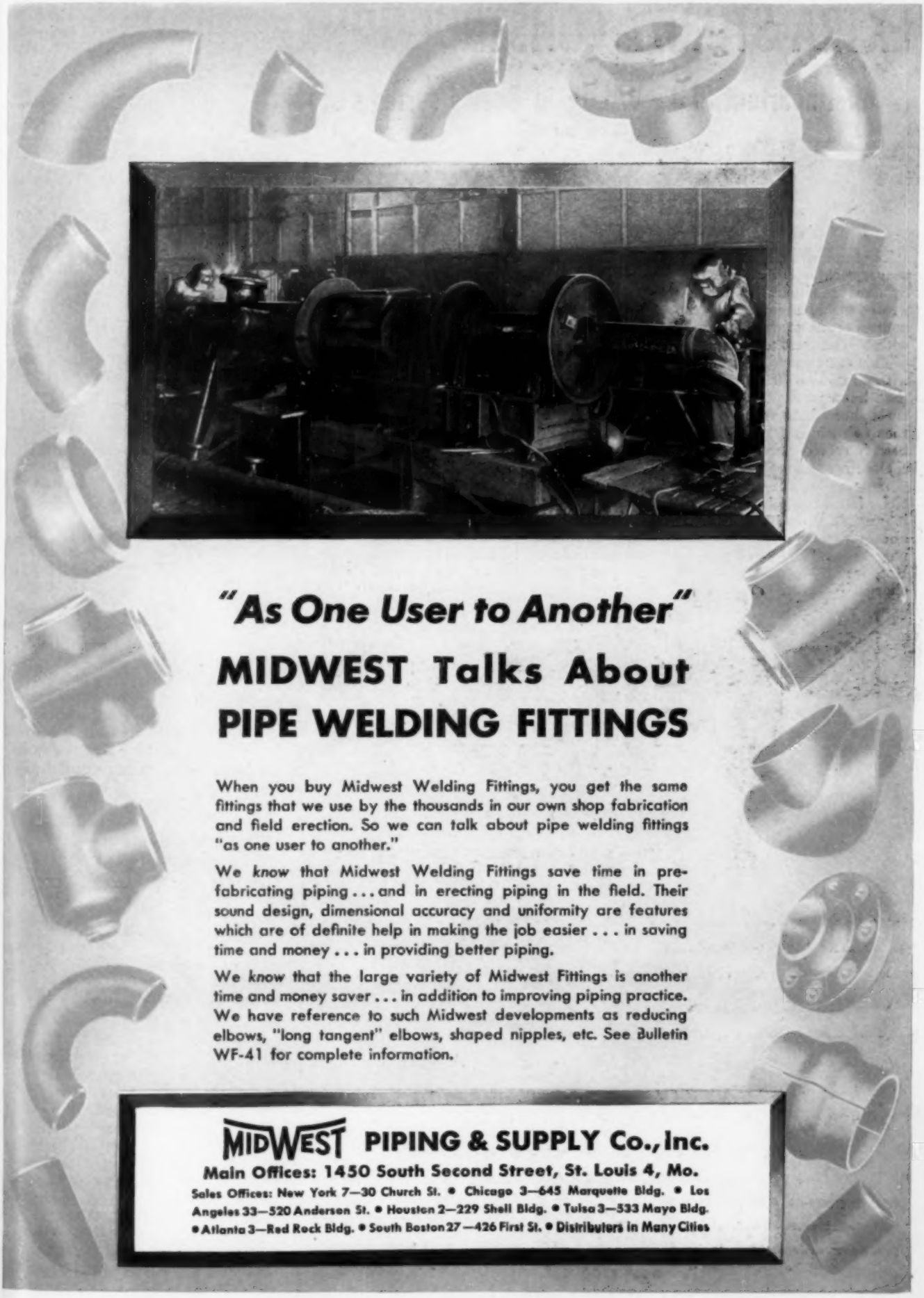
The M 8690-2 resin is prepared by reacting linseed oil with the castor oil and maleic anhydride. The reaction temperature is considerably higher so that ester interchange products as well as the half-ester of the castor oil are formed. The maleic anhydride also combines with the linseed oil. The complex mixture which results has a high viscosity. Along with styrene and quinhydrone, finely powdered mica is added as a filler to give a low viscosity-temperature gradient which enables the material to bridge gaps and to give better covering on sharp edges. When benzoyl peroxide is added to the resin mixture, flexible films form upon baking. The styrene reacts with the resin and becomes part of it rather than volatilizing with the formation of bubbles and pin-holes.

N. C. Foster, Westinghouse Research Laboratories, before The Electrochemical Society, Toronto, Oct. 18, 1946.

ADDITION AGENT FOR ELECTROLYTIC REFINING OF Sb AND Pb

Hexanol-3 tails, phenol coefficient 16, was found to be an excellent addition agent for the electrolytic refining of tin from a stannous sulphate-sulphuric acid electrolyte, 1.93 lb. being required per ton of tin refined. In the electrolytic refining of lead from the fluosilicate bath, 0.8 lb. is required per ton of metal refined. Hexanol-3 tails is a complex mixture containing phenolic compounds that remains after the higher tar acids have been removed from certain coal tar distillation fractions. These impure mixtures of aromatic hydroxy compounds of the higher homologs of phenol are better addition agents than the corresponding pure compounds or mixtures of pure compounds.

During the tests, the extremely small quantities of hexanol-3 tails required



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were added as a 1 percent solution in ethanol. A method, using the principle of partition, was developed to supply the electrolyte with addition agent continuously.

A solution of equal volumes of hexanol-3 tails and a high specific gravity, bath-insoluble liquid was placed in the cell below the electrolyte. After several hours, sufficient addition agent dissolved in the electrolyte for the electrolysis to give an excellent cathode deposit of tin. The addition agent consumed during electrolysis was replaced continuously by solution from the concentrated solution in the heavy liquid "holder."

A continuous test of three months duration was made using this method of adding hexanol-3 tails with ethylene bromide as the solvent. Whenever the appearance of the cathode deposit indicated that insufficient addition agent was being supplied to the electrolyte, more was added to the holder. This new method of adding a slightly soluble, oil addition agent gave such excellent results and was so simple in operation that it should be used more extensively.

Frank C. Mathers, Indiana University, and Maurice M. Felger, General Electric Co., before The Electrochemical Society, Toronto, Oct. 16, 1946.

CHEMICAL ASPECTS OF ATOMIC ENERGY

CHEMISTS have little to do with the actual fission of elements in the atomic pile; but before and after the fission they are vitally concerned. Not only must they purify the original consituents, but must also separate the products, the radioactiviy of which is many times that of the radium. In the atomic bomb some 20 products had to be separated from behind thick walls without ever being seen. The method had to be completely worked out before the first pile was operated, and the chemists' only guide was a few millionths of an ounce of radioactive material. In addition, problems of corrosion, temperature and radiation had to be solved.

Use of atomic energy resolves itself into two possibilities. In the first of these, direct use of the energy produced, the problems of corrosion, temperature, and radiation would again have to be solved. Since heavy shielding material would have to be used, the process would at first be stationary, although later it might be used for boats and large airplanes. It cannot be said whether economics will permit wide use, although certain uses will be made feasible.

Second broad possible use of atomic energy is chemical tagging. The most important use will be in the laboratory and will lead to a better understanding

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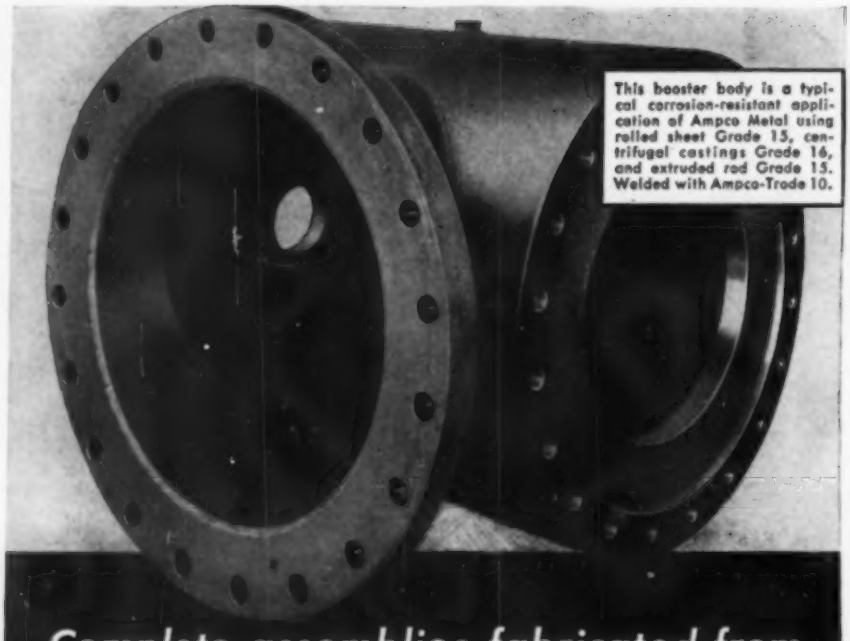
- **SIMPLE INSTALLATION.** Only two pipe connections to make. Light enough in weight to be supported in line.
- **SELF-CONTAINED.** No external float boxes or float valves required. All moving parts accessible without disturbing pipe connections.
- **TROUBLE-FREE PERFORMANCE.** Only three moving parts. Immune to ordinary dirt troubles. Non-air binding. No stuffing boxes to keep tight.

Ask for interesting descriptive literature. ARMSTRONG MACHINE WORKS, 858 Maple St., Three Rivers, Mich.

ARMSTRONG *Inverted Bucket* STEAM TRAPS

Over a Million in Use... For Power... Process... Heating


This booster body is a typical corrosion-resistant application of Ampco Metal using rolled sheet Grade 15, centrifugal castings Grade 16, and extruded rod Grade 15. Welded with Ampco-Trode 10.

Complete assemblies fabricated from

Ampco Metal

...and welded with

Ampco-Trode

Coated Aluminum Bronze Electrodes

Longer life...lower cost on units for processing corrosive substances:

In the routing of liquids, semi-fluids, and liquids containing solids in suspension, such as

- Acids
- Petroleum sludge
- Alkaline solutions
- Sea water
- Mine waters
- Food product liquors
- Hot brine

. . . Under varied conditions of

- Corrosion
- Velocity
- Temperature
- Pressure
- Consistency

. . . a combination proved successful where corrosion-resistance is essential

The wisdom of *fabricating with Ampco Metal* and *welding with Ampco-Trode* is being demonstrated daily — in the original construction of complete units subject to corrosive action, as well as fabricated parts.

Ampco Metal is a complete series of aluminum bronze alloy variations, available as castings, forgings, sheets, rods. All surfaces, whether cast or machined, are protected naturally by an oxide film that provides additional resistance against corrosive attack. This film, when injured, replaces or heals itself.

In addition to its ability to withstand the destructive action of a wide range of caustics and acids, Ampco Metal has other desirable service qualities not found in other anti-acid metals: High tensile strength. Good ductility. Less weight. Favorable hardness to resist squashing, wear, impact, fatigue.

Ampco-Trode coated aluminum bronze electrodes give a weld with the same excellent physical properties that Ampco Metal provides in the component parts.

Ask our engineers and production specialists to help you adapt fabricated assemblies to your requirements. Send us your prints for suggestions. Write for bulletins.

Ampco Metal, Inc.

Department CM-1 Milwaukee 4, Wisconsin

Field Offices in Principal Cities

AMPCO Metal

The Metal without an Equal

P-12

of fundamentals. For example, the oil industry will use tracers in studying cat cracking and synthetic oil production. There will be other uses in biochemistry, analytical chemistry, photosynthesis, manufacture of drugs and medicinals, and in determining the mechanism of all sorts of chemical reactions. It is possible that radioactive isotopes might themselves act as catalysts in certain reactions.

There are 400 or 500 radioactive isotopes known today; and it will be the job of the chemist to separate them. This may become a major chemical industry in this country, and later, in the world. It will lead to new products, processes and improvements through research.

Glenn T. Seaborg, University of California at Berkeley, before the University Extension Center, San Francisco, Oct. 18, 1946.

BEHAVIOR ACCIDENTS

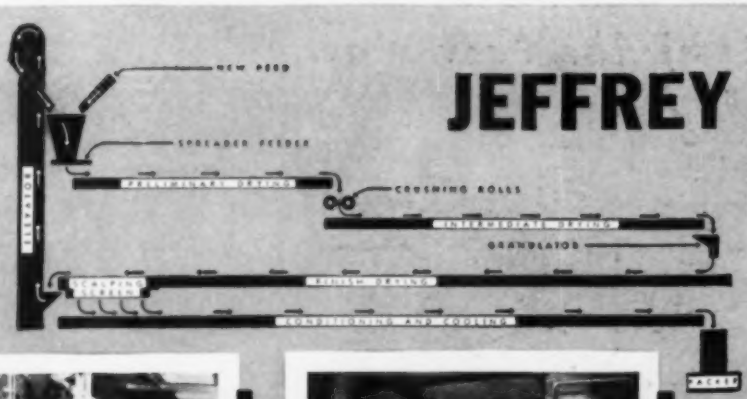
"BEHAVIOR" accidents result from the failure to follow established procedures and to use prescribed safety devices. This class of accidents must be prevented at the source—the individual.

Behavior is ordinarily caused, rather than a spontaneous phenomenon. Officials responsible for a safety program must get at the reason why men fail to follow instructions. This called for a study of the man, the conditions of his job and the adequacy of the instructions given him. The following is offered as an eight-point safety program to cope with behavior accidents: Development of a basic program, selling the program to the workers, outlining safe practices, training the workers, constant emphasis on training, encouraging workers to "see" what they look at, discovery of causes for behavior failures, and treatment of the causes.

J. F. Agar, Michigan Bell Telephone Co., before 1946 Fall Safety and Fire Conference, Washington, D. C., Nov. 15, 1946.

PATENTS AND PRICES

THE CHARGE has been made that the price of exclusively patented drugs is higher than the price of those generally available. This is not generally true but undoubtedly, true in some instances. However, there are mitigating factors which are not generally considered by those who find this a serious objection to the prevailing patent system. In the first place there is no consistent correlation between high price levels and patents. The laws of economics apply to patented articles as well as others and most manufacturers don't need to be taught that they can make a greater total profit by selling more units at a reasonable price than by holding the

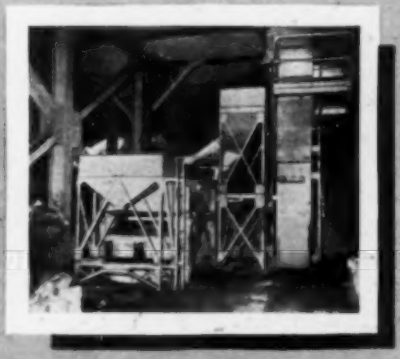
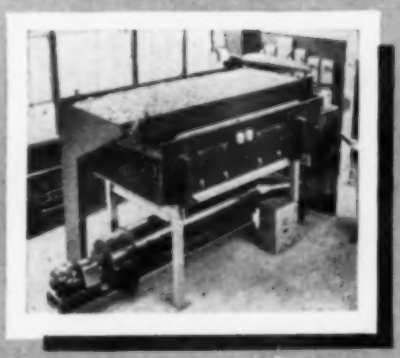
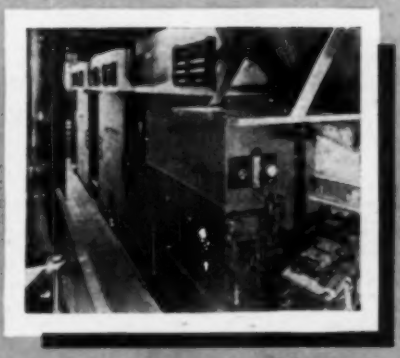
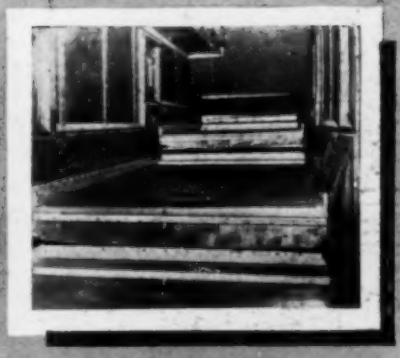


JEFFREY TRAYLOR

ELECTRIC VIBRATING DRYERS

(PATENTED)

A Few Typical Installations

THE JEFFREY MANUFACTURING COMPANY

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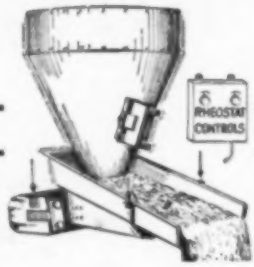
Baltimore 1 Buffalo 2 Cleveland 13 Huntington 19 Milwaukee 11 Pittsburgh 22
Birmingham 3 Chicago 1 Denver 2 Houston 6 New York 7 St. Louis 3
Boston 16 Cincinnati 2 Detroit 13 Philadelphia 3 Salt Lake City 1
Sarnia 3

ESTABLISHED 1877

MOVE MATERIAL *the Easy Way*
with SYNTRON



"Pulsating Magnet"

ELECTRIC VIBRATORS

Assuring free-flowing bins, hoppers and chutes. Prevent arching and plugging. Eight models—for all sizes and shapes of bins.

"Vibra-Flow"

VIBRATORY FEEDERS

Controlling the feed of bulk materials—hot or cold, dry or damp, a fine powder or big lump—to processing equipment.

Write for literature

SYNTRON CO., 610 Lexington, Homer City, Pa.

Industrial Alcohols

Low cost production depends largely upon original plant engineering and equipment design. The process is basically simple — it is the engineering and management of equipment detail that insures profitable operation.

Specialization, experience in distillery engineering, fabrication and construction is insurance of the finest sort for Hicks clients. Hicks plants and special distillery equipment are dependable low cost producers of industrial alcohols and potable spirits from a variety of fermentables in the United States and abroad.

Inquiries to us about any distillation project — complete plant or redesign of existing plants or equipment — will receive expert attention. Write S. D. Hicks & Son Company, 1661 Hyde Park Ave., Boston 36, Mass.

Hicks
CHEMICAL & PROCESS ENGINEERING

price where many cannot afford to buy. The record of the industry in reducing prices of patented drugs to levels where the public can afford to buy them is defensible. The fact that there are people too poor to purchase adequate food, clothing or shelter or drugs, is another problem and not necessarily a reflection on the patent system. But too often we find individuals on the one hand perfectly content to pay $6 for a bottle of whiskey, $3 for dinner and $15 for an evening's entertainment, and yet on the other, writing to their Congressman because they have to pay 5 or 6 dollars for something that saved them the expense of a funeral. The public's sense of values is farthest off the beam with respect to the worth of health and medical care. By and large it is the patented drugs that pay the way for drug research and the surest way to wither progress in the industry is to adopt measures which will make it impossible for a concern to enjoy that period of exclusiveness which the Constitution and the patent laws intended it to have.

T. G. Klumpp, Winthrop Chemical Co., before Radio Business Forum, New York, Oct. 1, 1946.

THE HIGH COST OF LABOR TURNOVER

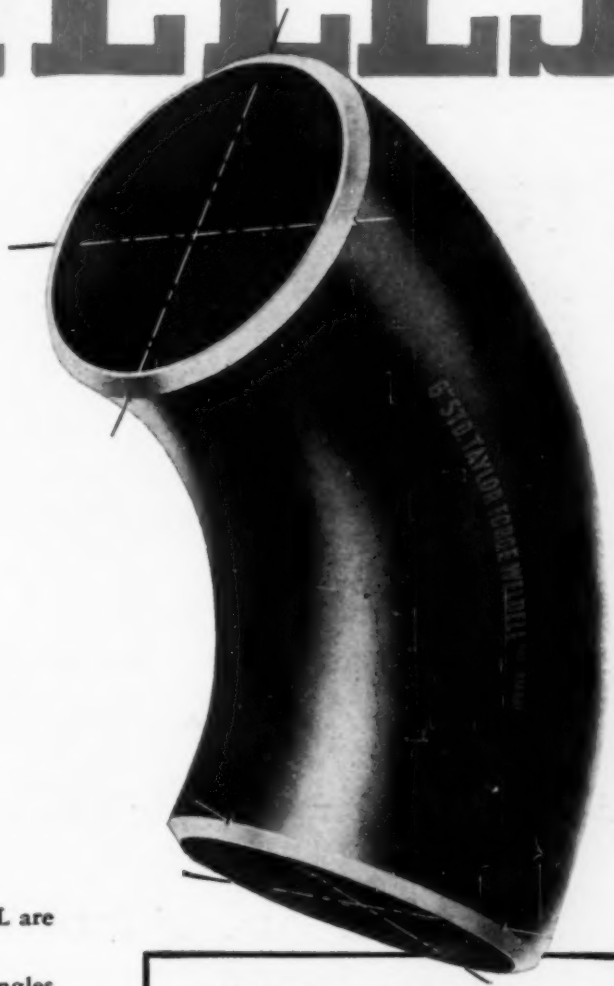
INDUSTRY can save millions of dollars yearly through the proper application of psychology in selecting technical personnel. Because of ineffective selection and placement, labor turnover alone represents a staggering financial loss in many companies. It has been estimated that the cost of hiring, training, and maintaining a single semi-skilled worker on the payroll of the average company for a period of one week runs well in excess of one hundred dollars. Moreover, a labor turnover of 8 to 10 percent per month is not unusual. In a plant employing 4,000 persons, the turnover may thus cost between $35,000 and $40,000 a month, or almost one-half million dollars per year.

Richard A. Fear, The Psychological Corp., before American Institute of Chemical Engineers, Atlantic City, Dec. 1, 1946.

ADVENTURES IN ELECTRO-CHEMISTRY

BEFORE 1860 the d.c. generator had been industrially developed so that the way was opened for its use to much advantage for the decomposition of common-salt brine, provided a method could be found for making continuous the initial effect of liberating chlorine at the anode and caustic and hydrogen at the cathode. In a simple non-diaphragm call this effect is hardly more than momentary. Thereafter the soluble products mix sufficiently to provide

WeldELLS



for example:

precision quarter-marked ends....

Those four points on each end of every WeldELL are small things to look for, but big things to find.

They make it far easier to follow center lines, angles and planes—save time, prevent errors.

Here is a feature that appeals to the practical man—an exclusive feature of WeldELLS—typical of the extra value you get in all Taylor Forge Welding Fittings.

Please note the list of extra-value features opposite. Who can doubt that a job welded with fittings which lack these features does not sacrifice something—in speed of installation, in economy, in soundness, in the lasting satisfaction that goes with using the *best!*

TAYLOR FORGE & PIPE WORKS

General Offices & Works: P. O. Box 485, Chicago
New York Office: 50 Church Street
Philadelphia Office: Broad Street Station Bldg.
Los Angeles Office: Oviatt Bldg.

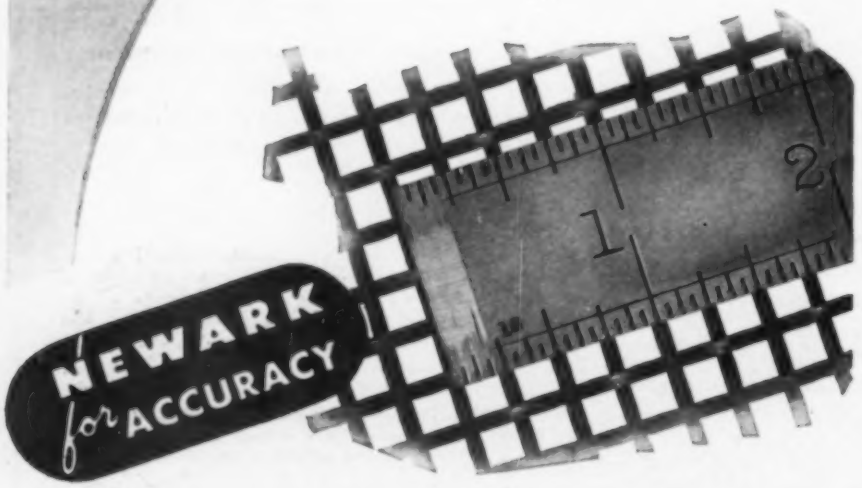
WeldELLS alone combine these features:

- **Seamless**—greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement**—provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

have everything

Decades of experience in the precision manufacture of accurate wire cloth and wire cloth fabricated products places NEWARK in an ideal position to recommend and supply the proper wire cloth for your processing.

NEWARK WIRE CLOTH is available in all commercial sizes, all weaves, all malleable metals, standard or special for every service.



Newark Wire Cloth COMPANY

350 VERONA AVE. NEWARK 4, N. J.

an oxygen-bearing salt in solution which diverts most of the current to decomposing water. If a diaphragm is used the same occurs although more slowly.

During my second year's vacation from MIT, (August 1888) I obtained excellent results in generating caustic and chlorine using a stationary mercury cathode, supported on a porous diaphragm, which received sodium at its under surface and, without the help of agitation other than the automatically obtained within it by the lightness of the amalgam which was formed at its under side, transferred such sodium-rich amalgam to its upper surface where it was oxidized and hydrated to form c.p. caustic.

This affair worked perfectly on the first trial, but I was keenly alive to the distance to be travelled to clothe the apparatus in the rugged appurtenances essential for producing low-priced chemicals. I was, moreover, much disappointed to find that, not only was there no industrial demand for pure caustic, but that a commercial article containing 10 percent or more of salt was preferred so long as the price was based on the caustic content.

When my next chance came to experiment (in the fall of 1889 in Boston) I devoted myself exclusively to the diaphragm cell. I tried various cell arrangements and, in the spring of 1890, built the one which embodied the principle of excess anolytic pressure on the diaphragm, with resulting tendency of anolyte towards the cathode, and of opposition of movement of catholyte towards the anode, which initiated an industrial revolution and has produced caustic and chlorine in vast tonnages. Its virtue lies in the principle which I discovered, and which I wish I could say I had foreseen, that whereas catholyte reaching the anode spells death to the efficiency, movement of anolyte to the cathode means only the loss of the dissolved chlorine, and its equivalent of caustic and hydrogen.

A test was run on my first successful cell in June 1890. Negotiations went forward for the erection of a small demonstration outfit at Bellows Falls, Vt., and I was busy there from Sept. 1890 to April 1891 in erecting it, and, for the latter six months, in running it continuously. Therefore very much time elapsed before things were arranged for going ahead industrially.

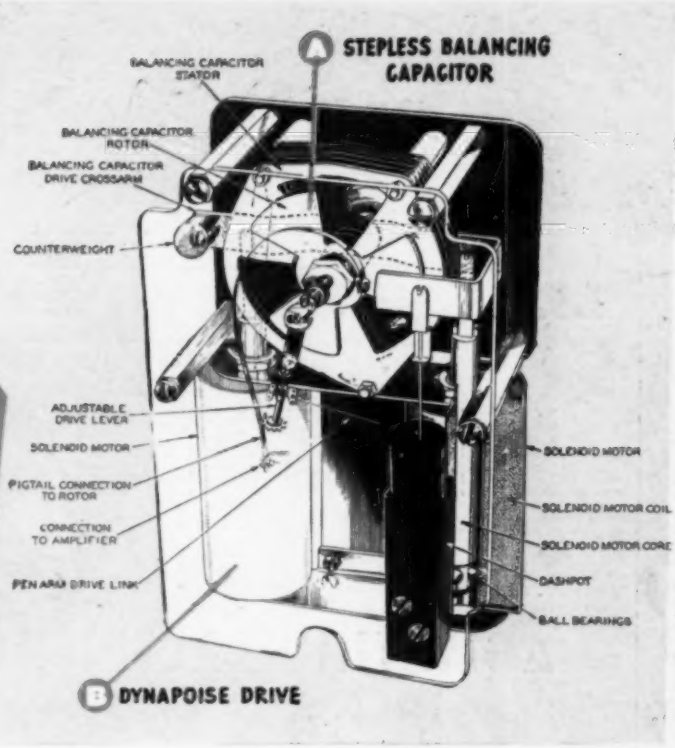
Effectuation of my process for keeping catholyte out of the anolyte was so simple, once you knew about the necessity for it, that all my cell-shed men became inventors of cells, and several took out patents. All these were for vertical diaphragms and they all worked, none well enough to survive.

Silence about the thirty years of un-

Only Dynalog Instruments offer

STEPLESS

continuous balancing!



. . . AND HERE'S THE MEASURING UNIT THAT PRODUCES IT

Of all the unique improvements featured in the new *Foxboro Dynalog Controller*, the Dynapoise Balancing Unit is by far the most revolutionary. It is the heart of the Dynalog principle . . . providing electrical movement and stepless balancing in their simplest possible forms. Only motions of small magnitude are involved. There are no complicated, or delicate mechanisms to wear or get out of order. The unit is ruggedly constructed and thoroughly protected.

The new Foxboro Dynalog Controller offers the proven advantages of both the Foxboro Dynalog Recorder and the new M-40 Controller. It has the absolutely continuous sensitivity and instantaneous response of the Dynalog principle plus the dependably-accurate control feature of *Permaligned* Construction found in the M-40 Controller.

Investigate the advantages of this Dynalog Electronic Controller for processes in your plant. Resistance bulb controllers are available now . . . thermocouple type, soon. Write for Bulletin 397. **The Foxboro Company, 16 Neponset Ave., Foxboro, Mass., U. S. A.**

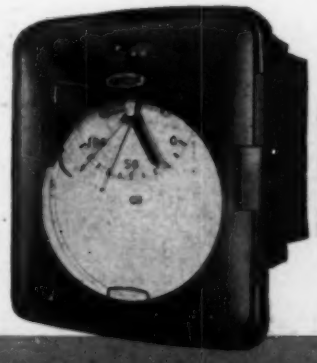
A — STEPLESS BALANCING CAPACITOR . . . a simple, rotating variable air capacitor provides friction-free, completely continuous balancing. No slidewire — no moving or intermittent contacts.

High Sensitivity . . . permanent positive balancing action on bridge unbalances of less than 15 micro-volts.

B — DYNAPOISE DRIVE . . . a powerful, poised, double-solenoid type device, directly coupled to balancing capacitor, moving only when instrument is rebalancing. No rotating motor with reducing gears. No brushes or bearings.

The Dynapoise drive with its short stroke eliminates mechanical reduction and permits instantaneous response to changes in measured variable. No fast-moving parts to stop and start. Only six moving parts including all linkage and pen arm. Each solenoid core has 3 ball bearings at the bottom to minimize friction with sides.

HIGH BALANCING SPEED . . . 3 seconds for full travel of pen or pointer



FOXBORO
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ELECTRONIC INSTRUMENTATION

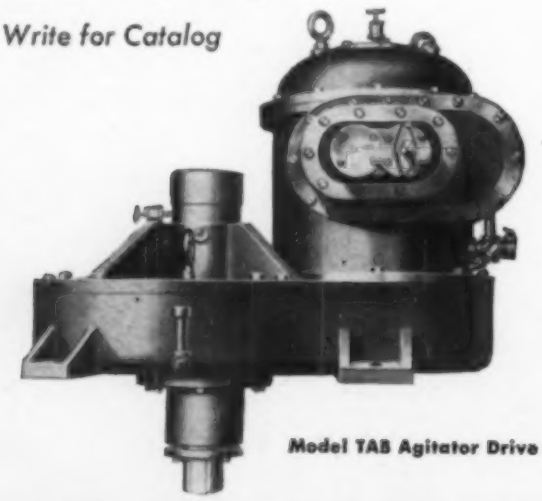
LET'S WORK TOGETHER

NETTCO

HAS THE AGITATING EXPERIENCE TO HELP YOU!

Since grandad was a boy Nettco has worked with thousands of processors to develop more efficient agitating equipment — to mix products better, faster, for less money. Nettco Agitating Equipment today, in gear ratios from 1 to 2,000 and speeds from ½ to 1750 R.P.M., can be economically assembled from Nettco standardized parts and units to meet your exact requirements. For better agitating equipment ask Nettco to work with you!

Write for Catalog



Model TAB Agitator Drive

NEW ENGLAND TANK & TOWER CO.
87 TILESTON STREET, EVERETT 49, MASS.

availing search before I discovered the fact that, while catholyte to the anode spelt death to the efficiency, anolyte to the cathode was almost harmless, has been absolute for half a century. On the other hand, those who have ever heard the name LeSueur think of it as applying to a cell that no one uses.

The variety in cell forms is legion. The LeSueur cell is an oblong, vertical-sided iron pan; inside it a box having brick walls and a perforated sheet-metal bottom, the latter covered with asbestos paper; a cover for the box made of slates; graphite anodes inside. The pan and perforated sheet are cathodic, the asbestos is the diaphragm. The sheet-metal bottom is preferably in the form of an extremely shallow V, the lowest point being about 3 in. lower than the extremities. This allows it, the cathode, to be run submerged (the usually preferred way) or unsubmerged or partly submerged. If it is to be run unsubmerged it may be left flat. The standard size (carried along from 1897) for the pan is 5x9x1½ ft. deep. The inside of the brick casing is a little over 4x7½ ft. It is run at a current density of about 45 amp. per sq.ft. of diaphragm. The practical merits of this cell are somewhat in proportion to its simplicity. I have had no connection with this cell for 48 years.

I believe I have done distinguished work in a direction you would hardly guess. It is as a manufacturer of inventors. That, however, is merely by the way. I made them all over the world when I discovered and published the virtues of the excess anolytic pressure.

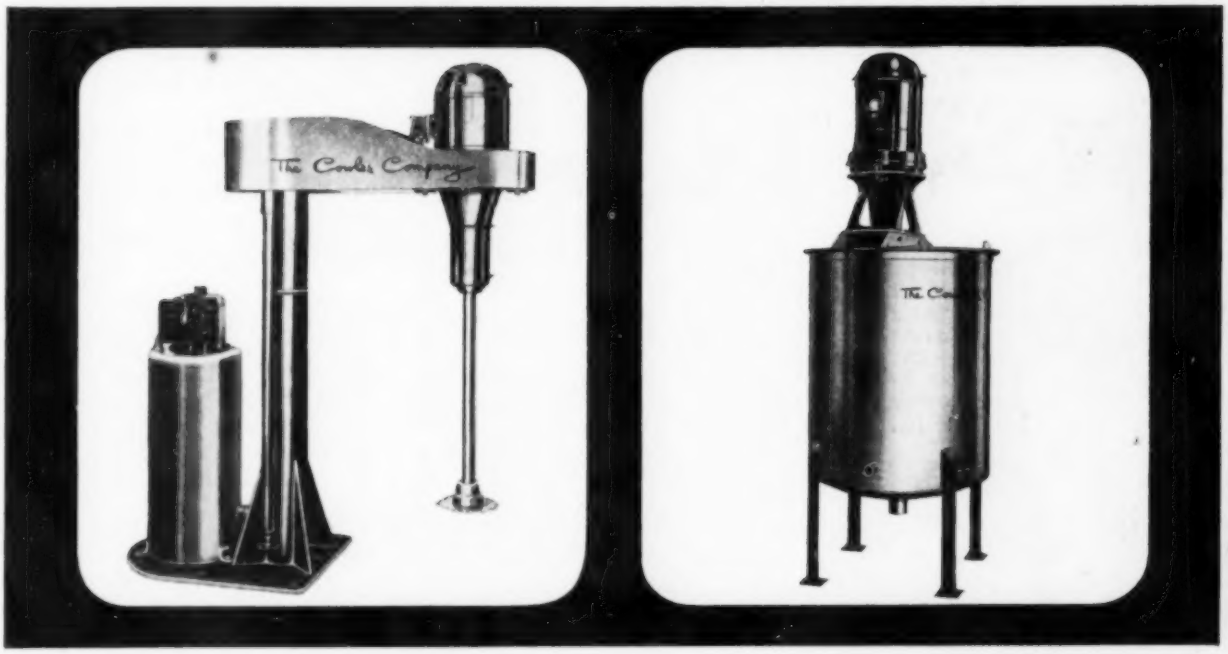
Ernest A. LeSueur, before the Society of Chemical Industry (Canada) and the Chemical Institute of Canada, Toronto, Nov. 28, 1946.

CONDUCTIVITY MEASUREMENTS OF CARBON BLACKS

INCREASING use during the last decade of "conductive" carbon blacks in dry cells, conductive rubbers and conductive plastics has resulted in the development of a large number of special carbons of this type. The properties demanded in these carbon blacks differ considerably from those expected in ordinary rubber blacks and new methods of evaluation had to be developed. Specific conductivity, that is, the inherent conductivity of the particles themselves, is one of the more important properties. Actually this is not measurable by any simple method, since the total conductivity of a mass of particles is dependent on the electric contact between the particles. The measurement of the bulk resistivity is, however, an important test in comparing different conductive blacks.

The results obtained when the black

Now—dissolve or disperse 25 minutes to 10½ hours faster



COWLES DISSOLVER

the high-speed machine with molecular-scrubbing action

Two to twenty times faster than conventional mixers, the scientifically designed impeller of the Cowles Dissolver turns at a high rate of speed. It sets up components of laminar flow, resulting in interface shear between multiple surfaces of molecular thickness, each moving at a rate different from its neighbors. The high velocity gradients of these laminae subject every particle of the materials being treated to molecular tensions and scrubbing, greatly accelerating the dissolving or dispersing action, holding undissolved residues to low levels and producing more homogenous mixtures. High viscosities improve the dissolving and dispersing action.

Safe, Silent, Long-Wearing

Sound design and rugged structure . . . plus finely machined materials of high physical properties . . . all assure maximum life with minimum maintenance requirements. A high degree of static and dynamic balance has been achieved in the rotating parts, eliminating noise, vibration, splash and dead spots. Turbulence and aeration are thus held at low levels, though controlled aeration can be had if desired.

Models With or Without Tanks

In two models—with built-in tanks in capacities of 100 gallons, 250 gallons and 500 gallons, or for use in tanks brought to the machine. Motor speed and horsepower adjusted to the need. Explosion-proof motors on special order. Write for descriptive folder, or ask for a technical representative to call.

5 Years of Commercial Test Show Cowles Dissolver Up to 10½ Hours Faster on Typical Operations

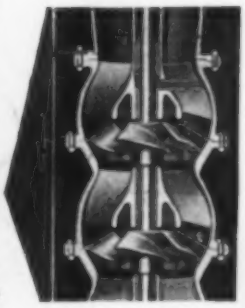
Type Operation	*Material*	*Cowles Dissolver*	*Standard Mixer*
Gum Cutting	Rosin	1½ Hrs.	12 Hrs.
Synthetic resin dissolving	Vinylite	1 Hr.	6 Hrs.
N/C solution	Nitrocellulose	12 Min.	90 Min.
Tinting	Enamel	5 Min.	30 Min.
Pigment dispersion	Heavy enamel	6 Min.	150 Min.
Coating suspension	H. T. Clay	1 Hr.	9 Hrs.

The Cowles Company • Cayuga, N. Y. *Associate: Alexander Fleck, Ltd., Ottawa, Ont.*

PEERLESS
Hydro-Foil PUMPS
Move huge volumes of water against low and medium heads

PEERLESS MIXED-FLOW PUMPS
CAPACITIES: UP TO 220,000 G.P.M.

Cutaway view of Mixed-Flow multi-stage pump impeller and bowl construction revealing high efficiency impellers utilized for more economical water lift.



To rapidly move and re-move maximum amounts of water.

The most modern principles of aero and hydro-dynamic design are embodied in Peerless Mixed-Flow pump design and construction, attaining new high efficiencies in large volume water lift and lowering overall maintenance and pumping costs.

Numerous successful applications of Peerless Mixed-Flow Pumps include: drainage; sewer and flood control service; dewatering; irrigation water diversion; flooding of agricultural lands; industrial and process work including condensers, circulation of liquors, etc.

PROPELLER TYPE PUMPS

Peerless pumps, embodying the Hydro-Foil principle, are also available in the propeller type and are capable of handling identical capacities of the Peerless mixed-flow pump. Request Bulletin B-148 on design, construction and application data of these two outstanding types of Peerless Pumps, for large-volume water pumping.

PEERLESS PUMPS
PEERLESS PUMP DIV. FOOD MACHINERY CORP.
Los Angeles 31, Calif., Canton 6, Ohio, Quincy, Ill.
FACTORY BRANCHES: ARDMORE, PA.; DECATUR, ILL.; ATLANTA, GA.; DALLAS, TEXAS
DISTRIBUTORS PRINCIPAL CITIES

is compressed to a standard apparent density are more in accordance with performance of the black in dry cells and in electrically conductive rubber than those obtained with the usual method, in which conductivity is measured under a standard pressure. This is especially so with blacks possessing a highly developed chain structure.

In comparing resistivity of carbon blacks of widely different properties, standard pressure should not be used as the only basis, since the results may be quite misleading from the effect of the structure, of particle size, or of both, on the compressibility of the black. Resistivity at standard apparent density will give results more closely related to the actual resistivity of materials compounded from the blacks.

G. Benson, J. Gluck, and C. Kaufmann, Shawinigan Chemicals, Ltd., before The Electrochemical Society, Toronto, Oct. 19, 1946.

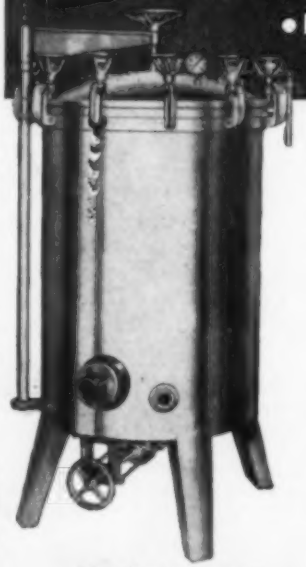
FOREIGN LITERATURE ABSTRACTS

CERAMICS IN COLOMBIA

COLOMBIA has a wide variety of raw materials suitable for use in the different branches of the ceramic industry, and in such large quantities that there would be enough to supply the demands not only of this country but also of its neighbors. The National Chemical Laboratory is continuing its petrographic, chemical and physical investigations of various materials in order to determine the properties of each, these data being essential for the study and determination of the clays, glazes, enamels and pigments. Public demands have consisted almost totally of requests for refractability tests, showing the importance of that branch of ceramics dealing with refractory materials. The ceramic industry is suitable for small-scale manufacturers, providing the State handles the more expensive technical processes, such as crushing, milling and mixing of the clays, and the preparation of frits, glazes, enamels and pigments. It is an industry without very great technical complications, but when the product must have special properties, such as resistance to shock, impermeability, color, resistance to acids and to sudden changes in temperature, refractability, etc., then it is necessary to have special knowledge in the fields of chemistry, physics, physical chemistry and modern methods of operation. These methods also require machinery which is not available to the small

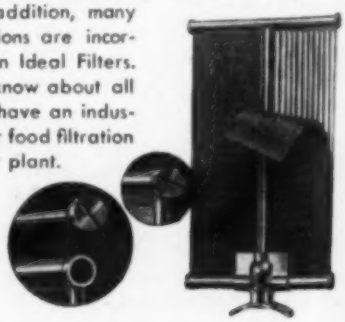
The Heart of a Good Filter is its FILTER LEAVES!

You Can Depend On KLEIN
FILTERS and FILTER LEAVES
• Positive Filtration . . . No Clogging
• Full Drainage



Klein Ideal Diatomaceous Earth Filters and the exclusive Klein Filter Leaves, in combination, assure positive filtration at all times. Operation, cleaning and maintenance costs are at a minimum with Klein Filters. In addition, many radical innovations are incorporated in Klein Ideal Filters. You'll want to know about all of these if you have an industrial, chemical or food filtration problem in your plant.

Write for latest Klein Bulletin



Klein Filter Leaf—If damaged, metal cloth easily replaced. No rivets. Note horizontal headers—central duct—Klein Cleanout Cap.

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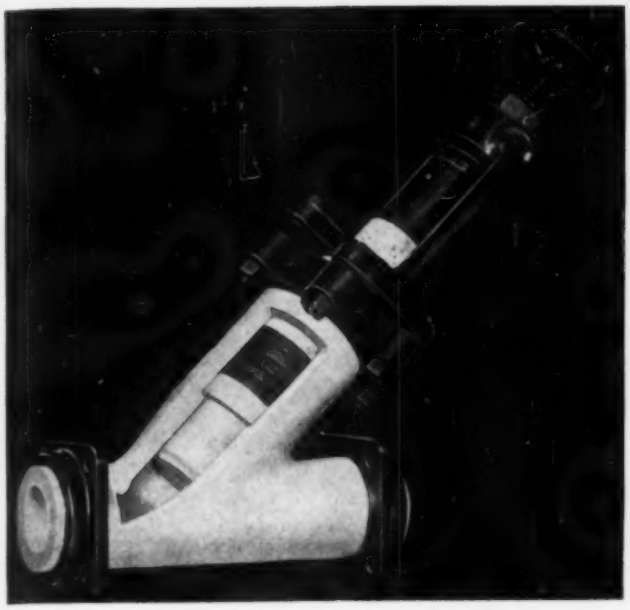
KLEIN
FILTER & MANUFACTURING COMPANY
1225-29 School Street • Chicago 13, Ill.



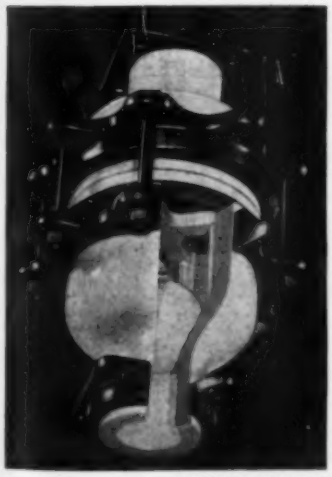
PORCELAIN IS A *Natural* CHEMICAL HANDLING MATERIAL

ILLINOIS PORCELAIN VALVES

ALL ILLINOIS Valves are very carefully designed to give maximum uninterrupted service life under normal operating conditions. The valve seat is located in the lowest possible position so that you get uninterrupted flow of material when stem is in open position. Packing is acid-resisting asbestos—graphite impregnated. The ends of valves are ground parallel for gasketing. All valves are tested 100 lbs. hydraulic pressure.

PIPE AND FITTINGS

ILLINOIS high quality porcelain pipe and fittings are very accurately cut to length. Ends are ground absolutely smooth for gasketing. Flanges are assembled so that the bolt holes are in line. The flange faces are parallel to the ends. The inside and outside is glazed white. The porcelain fittings used with pipe are ground at right angles and to exact dimensions. Installation is fast and simple.



CHECK VALVES

Ends are ground parallel for gasketing. Ball is ground and polished to exact sphere and the ball seat is ground and polished for perfect fit to completely shut off leakage past the ball. The guides for centering the ball are carefully ground to close tolerances. Liquid space around ball is ample to allow free flow.

Diaphragm limits rise of ball, preventing knocking. The perforations in the diaphragm are slightly greater than the inside area of the pipe. These vertical check valves can be installed in the line or as a foot valve.

Angle check valves are also available.

★Porcelain is a natural chemical-handling material because it does not deteriorate or corrode and electrolysis cannot take place — corrosion usually is the result of electrolysis and when high grade porcelain is used there can be no corrosion.

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ILLINOIS CHEMICAL PORCELAIN

ILLINOIS ELECTRIC PORCELAIN CO. *Macomb, Illinois*

businessman. If the government does not insist on carrying out its program of helping the small manufacturer, the ceramic industry will soon be monopolized by foreign and national firms with large capital.

Digest from "Ceramics and Its Initiation in Colombia" by Efren Diaz, *Revista Colombiana de Química* I, No. 1, 36-38, 1944-1945. (Published in Colombia).

PROPERTIES OF SOME METAL BROMIDE SYSTEMS

Viscosity, electroconductivity and specific gravities of the systems $SbBr_3$-$AlBr_3$, $ZnBr_2$-$AlBr_3$ and KBr-$AlBr_3$ were studied at different temperatures and different concentrations of the antimony, zinc and potassium bromides in the molten state. The molecular electroconductivity of the system $SbBr_3$-$AlBr_3$ forms two maxima, whereas that of the system $ZnBr_2$-$AlBr_3$ forms one maximum. Introduction of a correction for viscosity suppresses the maxima. The molecular electroconductivity curves, corrected for viscosity, have the same identical character for all three systems, in which the electrolytes are the complex compounds $KBr.Al_2Br_6$, $ZnBr_2.Al_2Br_6$ and $SbBr_3.AlBr_3$. The highest corrected molecular electroconductivity corresponds to the electroconductivity of the said electrolytes. The course of the curves for the corrected molecular electroconductivity supports the author's statement that every dissolved substance, on increase in concentration, tends to go over to whatever state is natural to it in the molten state, and that the highest corrected electroconductivity corresponds to the corrected electroconductivity of the electrolyte formed in the solution and being in a molten state. The relation of the corrected molecular electroconductivity to dilution can be expressed for concentrated solutions by the equation

$$\lg\mu = \text{const.} - \frac{m-2}{2}\lg\phi.$$

The isotherms of viscosity, specific gravity, molecular electroconductivity and corrected molecular electroconductivity form characteristic points for $SbBr_3$-$AlBr_3$ which correspond to the compound $SbBr_3.AlBr_3$.

Digest from "Physico-Chemical Investigations of Concentrated Solutions (Electroconductivity, Viscosity and Specific Gravities of the Systems $SbBr_3$-$AlBr_3$, $ZnBr_2$-$AlBr_3$ and KBr-$AlBr_3$ in the Molten State)" by E. J. Horenbein, *Zhurnal Obshchei Khimii* XV, 9-10, 729-744, 1945. (Published in Russia.)

POLYMERIZATION AND DRYING OF OILS AND ESTERS

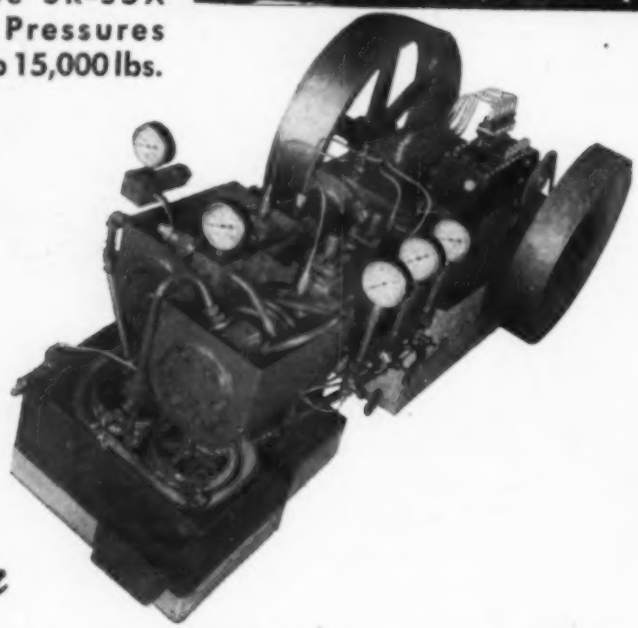
Oils and esters of fatty acids go over into the solid state as a result of intermolecular reactions. At low temperatures it is due to auto-oxidation and polymerization of the peroxides, at

Typical SINCE N 1865

HIGH PRESSURE NORWALK COMPRESSORS

300 to 15,000 psi.

Example No. 1 5-Stage Duplex Compressor Type SR-S5X for Pressures up to 15,000 lbs.



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We offer this rugged, high-capacity compressor to the Process Industries, with confidence that it will give many years of satisfactory service under severe conditions of operation. The Norwalk Type SR-S5X, as noted above, is a 5-stage Duplex Compressor, built to assure accessibility to all valves. Force feed lubrication is provided throughout. The running gear is equipped with Timken Roller Bearings. Each stage is water-jacketed and has ample cooling coils. It may be operated with any type of drive.

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as advanced by

CHICAGO METAL HOSE CORPORATION

Photograph by courtesy of Standard Oil Company of California.

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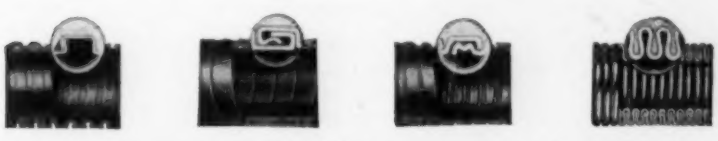
• Rex-Weld, Rex-Tube and Rex-Flex are *branded* flexible metal hose. Each of these—as well as C.M.H. Stainless Steel Bellows, Compensators and allied products—is manufactured with the increased product knowledge which the Science of Flexonics makes possible.

Chicago Metal Hose Corporation continues to devote its energies to this science. Just as C.M.H. has developed new *basic* products in the past, so it continues that development. These accomplishments—and this continued progress—have resulted in recognition of Chicago Metal Hose as the leader in the design and manufacture of flexible metal hose and allied products. For product application guidance, C.M.H. has data available—derived from the Science of Flexonics. Chicago Metal Hose Corporation welcomes the opportunity of putting its knowledge of this science to work for you.



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Maywood, Illinois • Plants: Maywood and Elgin, Illinois

Only the NEW TYPE "R" MORRIS SLURRY PUMP has these 4 FEATURES!

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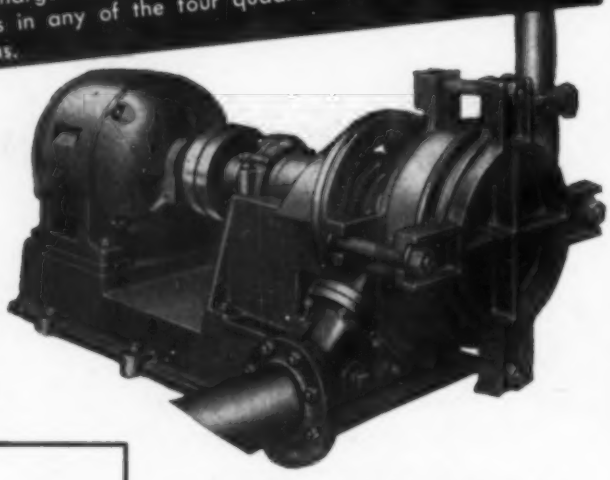
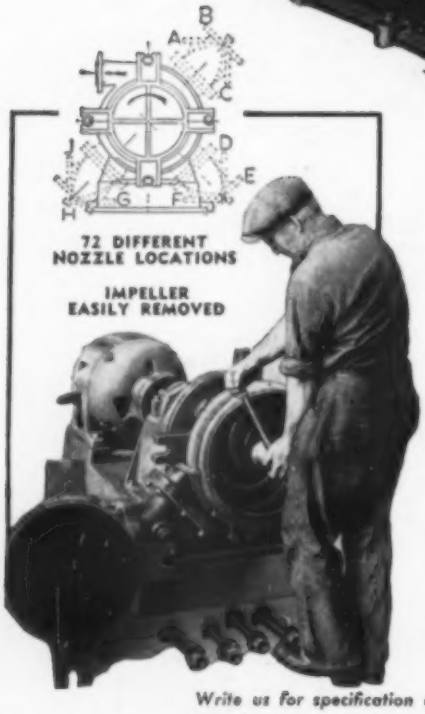
3. You can remove the impeller and liner without disturbing piping.
4. Shell interchangeable for right or left-hand rotation. Suction and discharge nozzles can be rotated around axis of pump to positions in any of the four quadrants, a total of 72 combinations.





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The New Type "R" Morris Pump—the most advanced design in the pump field—is specifically engineered to handle sludges and silt; the moving of all types of caustic or acid mixtures containing abrasives or solids; and mixtures containing ore concentrates, tailings, slag, and the residue from filters and classifiers.

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high temperatures to oxypolymerization and polymerization. The content of O_2 decreases with the increase in temperature. These processes lead to an insoluble trimeric polymer. The processes of molecule growth: polymerization, oxypolymerization and drying, are accelerated with increase in the number of double bonds (and their conjugated distribution) in the ester, whether this is attained at the expense of the unsaturated condition of the acid radical, or at the expense of the alcohol radical. The role of the following grows simultaneously: (a) intermolecular reactions and (b) coordination processes. Oxidation or auto-oxidation of the esters and fatty acids at the double bonds involves increase in the molecules, that is, oxypolymerization and conversion to the solid polymer but, without the occurrence of intermolecular reactions, this is provided either by the branched structure of the ester (at the expense of the polyatomic alcohol) or by a sharply increased unsaturated state of the acid radical.

Digest from "Investigation on the Polymerization and Drying of Oils and Esters of Fatty Acids. VII. On the Theory of Solidification and Drying of Oils and Esters of the Fatty Acids" by A. J. Drinberg, *Zhurnal Prikladnoi Khimii* XIX, No. 3, 251-257, 1946. (Published in Russia).

DETERMINATION OF VITAMIN B_1

THIAMINE oxidized by potassium ferricyanide is converted into thiochrome, which has a yellow color with a strong blue fluorescence, and can be determined either fluorometrically or by titration of the reduction product, the ferrocyanide, by means of ceric sulphate and an oxydimetric indicator: setopaline S, orthophenanthroline or erioglaucine. In the determination alkaline ferricyanide is added to 1 cc. of a soluble type of thiamine, the mixture gently agitated for one minute, measured exactly with a chronometer, acidified with sulphuric acid and treated with several drops of setopaline solution. Titration is carried out with the ceric sulphate solution until the golden yellow color changes to brown. A blank determination is run off first, and then the determination with the solution to be analyzed containing from 0.5 to 2 mg. of thiamine. The same mode of procedure is used for micro-determination of quantities from 5 to 20γ, but with more dilute reagents than for the macro-determination. In cases where thiamine exists in the presence of reducing materials, these have to be eliminated beforehand according to the procedure suggested by Tauber.

Digest from "Reaction of Thiochrome and New Method of Determining Vitamin B_1" by C. A. Payva Carbajal, *Bol. Soc. Quim. Peru* 8, No. 2, 105-119, 1942; *Chimie et Industrie* 56, No. 4, 294, 1946. (Published in France).

CHEMICAL ENGINEER'S BOOKSHELF

Lester B. Pope, ASSISTANT EDITOR

WORKING MANUAL

STATISTICAL QUALITY CONTROL. *By Eugene L. Grant. McGraw-Hill, New York. 563 pages. $5.*

Reviewed by Hugh M. Smallwood

A TREMENDOUS amount of research in statistical theory was carried out during the decades following the first World War, both in this country and abroad. Characteristically, the American work led to a technique ideally adapted to the control of mass production operations. This development was initiated by Walter A. Shewhart and first given practical application in the factories of Western Electric Co.

Procurement of materiel in the second World War required emphasis on quality of product and economy of personnel usage. In order to meet these requirements, Shewhart techniques were widely disseminated throughout the fabricating industries. The necessary education was undertaken by various universities under the stimulus and active help of the Engineering, Science, and Management War Training program. One fruit of this educational program is the book "Statistical Quality Control" by Professor Grant.

This book is a conscientious and accurate presentation of the various forms of the Shewhart control charts, of procedures for the efficient inspection of materials, together with some general comments on instituting systems of statistical quality control.

Professor Grant has written a working manual addressed to people without any previous training in mathematical statistics. He has successfully presented clear instructions for using these methods, and has given objective analyses of how much and how little the methods can be expected to accomplish. Statistical theory is kept at a minimum. The text contains 45 examples of use of statistical quality control methods in industry. These, for the most part, represent case histories which serve to illustrate what can be accomplished by use of these methods. Numerous problems are included in the text. These should be of value to the reader, particularly if he has access to someone experienced in this type of work who can criticize and discuss the answers to the problems.

Chemical engineers will find much that is elementary in this book and will be asked to take on faith some propositions which he might wish to have had derived. These comments follow from the author's keying of the book to personnel with little more than a knowledge of common arithmetic.

Statistical quality control has found its principal application in the production of machined parts, so-called nuts, bolts and screws. In consequence, most of the examples in the book deal with problems involving production of this type of material. The chemical engineer may feel that his problems are "different" and that these procedures will not apply to either batch or continuous production of chemicals. This feeling is quite erroneous, but it must be admitted that imagination is needed to formulate applications to new industries. The needed imagination, of course, cannot be supplied by any text but must be brought to new applications by those who carry them out.

Professor Grant's book can be heartily recommended as a guide for those who require a working knowledge of the application of statistical methods to control of manufacturing operations. Its contents should be thoroughly assimilated by all technically trained people who are desirous of improving quality and uniformity of product, or decreasing manufacturing costs. Any serious approach to these problems requires a working knowledge of statistical methodology. This book offers a practical, down-to-earth approach to this knowledge.

BRAINS MOBILIZED FOR WAR

SCIENTISTS AGAINST TIME. *By James Phinney Baxter, 3rd. Little, Brown and Co. with The Atlantic Monthly Press, Boston. 473 pages. $5.*

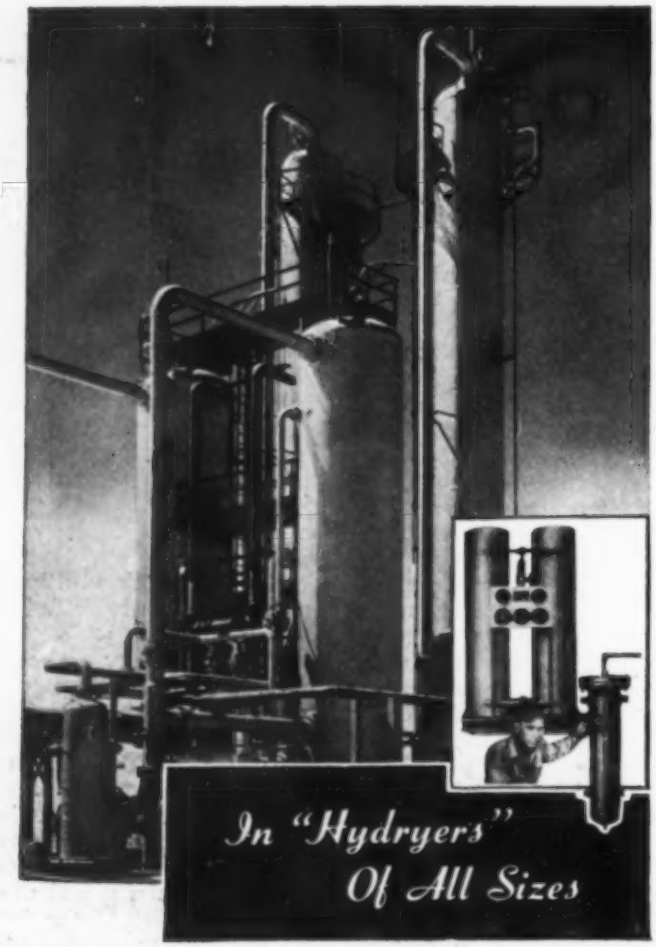
Reviewed by H. C. Parmelee

Now it can be told—at least as much of the story as conforms to the security regulations of the Army and Navy in force in May 1946, when the Joint Security Control cleared this book for publication. But even if some wartime research projects remain top secret, this volume reveals enough of the activities of the National Defense Research Committee and the Office of Scientific Research and Development to fascinate the reader and thrill him with pride at the accomplishments of Allied scientists against the Axis.

The history begins in June 1940, when the NDRC was created, one and one-half years before Pearl Harbor, and continues with the organization of OSRD one year later. Certainly our scientists were forehanded in mobilizing technical knowledge and skill for national defense, a project in which they had the hearty cooperation of their confreres in England and Canada who were already in the war. Within a year after the creation of OSRD it had 6,000 scientists working in college and industrial laboratories through the nation—a model of decentralized research that functioned with negligible disloyalty and threat to security. One measure of its success is the fact that by the spring of 1945 the Army and Navy had bought more than $4 billion of research-sponsored equipment developed in the race for superiority in new weapons. Problems were attacked and solved on all fronts—submarine and surface naval warfare, land and air operations, and in the development of those hybrid vehicles that performed so conspicuously in amphibious warfare. Nor were our scientists of the cloistered, armchair variety. They visited all theaters of war and learned at first hand the problems with which they had to deal. Frequently they had to instruct the armed forces in the use of newly developed devices.

Radar (radio detection and ranging) and Loran (long range aid to navigation) received early and extensive attention on account of their almost universal application in all forms of warfare. One hundred and fifty radar systems were developed for ground, ship and airborne use. Loran stations enabled aircraft to operate at long distance at sea, aided surface vessels to rendezvous for convoys, and guided aircraft over "the Hump." Radar beacons made possible blind landings by aircraft, and contributed to the accuracy of bombing by night or through overcast. Radar countermeasures also were developed.

The German submarine menace, vastly greater in the second World War than in the first, spurred our



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scientists in the development of anti-submarine devices. NDRC devised for the airplane two aids for underwater detection, the magnetic airborne detector and the expendable sonobuoy. The latter transmitted by radio to the plane whatever underwater sounds it heard.

For air warfare NDRC developed improved gun liners, new explosives for bomb and depth charges, rockets, and frangible bullets for training aircraft gunners. The effects of noise on air crews were studied, and improvements were made in intercommunication systems at high altitudes. Target-seeking and guided missiles also were developed.

Ranked among the "three or four most extraordinary scientific achievements of the war" was the proximity fuze program which resulted in radio fuzes that would operate not by time but by proximity to the target. They were marvels of construction requiring rugged electronic tubes and batteries and the finest workmanship, but they were finally made in large numbers for naval, ground and air forces.

Mention must be made of those unique amphibious vehicles, the Dukw and the Weasel, which performed marvelous feats of transportation of men and material during landing operations. At the end of the war there were 76 Dukw companies of 50 Dukws each, manned by about 13,000 Army and Marine Corps troops.

Chemistry, of course, played an important rôle in the development of new explosives and propellants. The "shaped charge" and the bazooka gave an infantryman an effective defense against enemy tanks. Gas, although not used in the war, was nevertheless the subject for much research and experimentation. Then why was it not used? The answer seems to lie in mutual fear and distrust of the warring nations, as well as in the almost superstitious fear of the weapon by soldiers and civilians alike. And yet incendiary bombs and flame throwers were accepted and used by all.

Military medicine is discussed at some length, covering antimalarials, blood and blood substitutes, penicillin, insecticides and rodenticides, and the medical problems peculiar to aviation.

The last chapters of the book are devoted to the atomic bomb, relating the long period of research in which scientists of international repute participated, and the final triumph of the "Manhattan District." The epilogue is a timely appraisal of the folly of a future war, and the "need to muster in the field of international relations as much inventiveness and engineering skill as was required to produce the bombs themselves." United Nations take notice.

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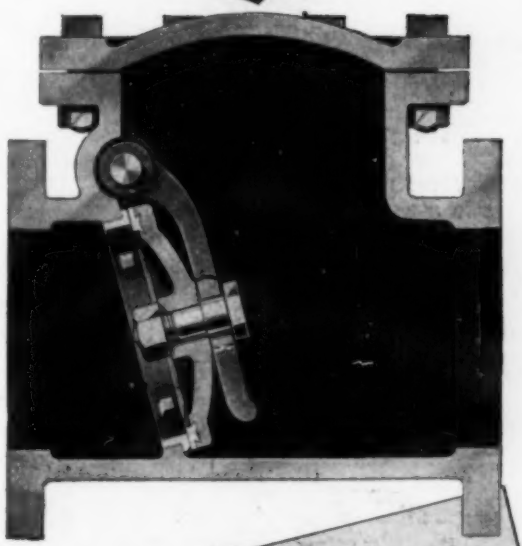
Kennedy Iron Body Swing Check Valves are far more than merely a tee fitted with a swinging disc. The angle of the disc has been carefully determined to assure easy opening at low pressures and to minimize the shock of closing under high pressures. In addition, the disc is designed to revolve and to be self-adjusting, so that it will not stick on the seat, and will be thoroughly reliable and positive in operation.

Bronze mounted valves have bronze seat rings screwed into the body, and all iron valves can be furnished with malleable iron screwed seat rings. Discs may be bronze-faced, leather-faced or all iron. These valves are furnished in a full range of standard sizes in standard and 250-lb. designs and will operate in either horizontal or vertical position. Write for the 240-page Kennedy Catalog describing these valves in detail, together with the extensive Kennedy line of valves and pipe fittings for all standard requirements.



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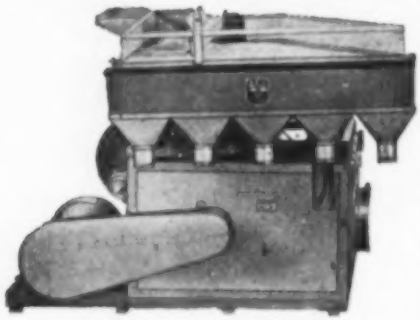

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GOVERNMENT PUBLICATIONS

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Trade Agreement Digests. U. S. Tariff Commission. A series of mimeographed summaries of data prepared for use in trade agreement negotiations. There will be 16 volumes corresponding to the 16 major schedules of the tariff law. Those of principal interest to readers of Chem. & Met. are, of course, the parts of Volume I which give various chemicals, oils, and paints data. Complete sets are not available. Inquiries should indicate the specific commodities and the specific paragraphs of the Tariff Act which are of interest. Material will then be supplied to inquirers so far as available. Those making market studies but unable to get data wanted can consult the information at the offices of the U. S. Tariff Commission.

List of Intercepted Plant Pests, 1945. Unnumbered document. Bureau of Entomology and Plant Quarantine, issued November 1946. This is part of the "Service and Regulatory Announcement" series showing the pest interceptions and indicating the type of insecticide problems which would have occurred except for close plant quanantine at the boundaries of the United States. Available only from Bureau of Entomology and Plant Quarantine, Washington 25, D. C.

Thermodynamic Properties of Ammonium and Potassium Alums and Related Substances, With Reference to Extraction of Alumina from Clay and Alunite. By K. K. Kelley, et al. Bureau of Mines, Technical Paper 688. Price 20 cents.

Carbonizing Properties of Western Coals. By D. A. Reynolds, et al. Bureau of Mines, Technical Paper 692. Price 20 cents.

Exploration of the Bourbon Magnetic Anomaly, Crawford County, Missouri. By W. D. McMillan. Bureau of Mines, Report of Investigations R. I. 3961. Mimeographed.

Exploration of the Brutch Sulfur Deposits, Hot Springs County, Wyo. By Forest H. Majors. Bureau of Mines, Report of Investigations R. I. 3964. Mimeographed.

Inflammability of Gasoline Vapor-Air Mixtures at Low Pressures. By G. W. Jones and I. Spolan. Bureau of Mines, Report of Investigations R. I. 3966. Mimeographed.

Exploration of Contact Manganese Mine, Grant County, N. Mex. By Paul L. Russell. Bureau of Mines, Report of Investigations R. I. 3969. Mimeographed.

Preparation of Manganese Electrolyte From Manganese Mattes and Pure Oxides. By David Schlain. Bureau of Mines, Report of Investigations R. I. 3976. Mimeographed.

Method of Assaying Oil Shale by a Modified Fischer Retort. By K. E. Stanfield and I. C. Frost. Bureau of Mines, Report of Investigations R. I. 3977. Mimeographed.

Colorimetric Phosphate Tests for Boiler Waters Containing Tannin. By L. Goldman and R. N. Love. Bureau of Mines, Report of Investigations R. I. 3983. Mimeographed.

An Investigation of a Laboratory Test for Determination of the Free-Swelling Index of Coal. By W. A. Selvig and W. H. Ode. Bureau of Mines, Report of Investigations R. I. 3989. Mimeographed.

Studies on Explosives and Explosions, Fiscal Year 1945. By Wilbert J. Huff. Bureau of Mines, Report of Investigation R. I. 4031. Mimeographed.

Design and Operation of the Coal Planer, Ruhr District, Germany. By John W. Buch.

Recent National Pump Survey Shows:

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IN A recent national survey, Viking Rotary Pumps led the rotary pump field in popularity and widespread use. Vikings topped the field, being encountered 29.1% of the time among 17 makes of rotary pumps listed.

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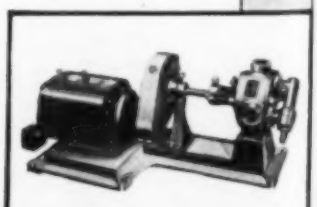

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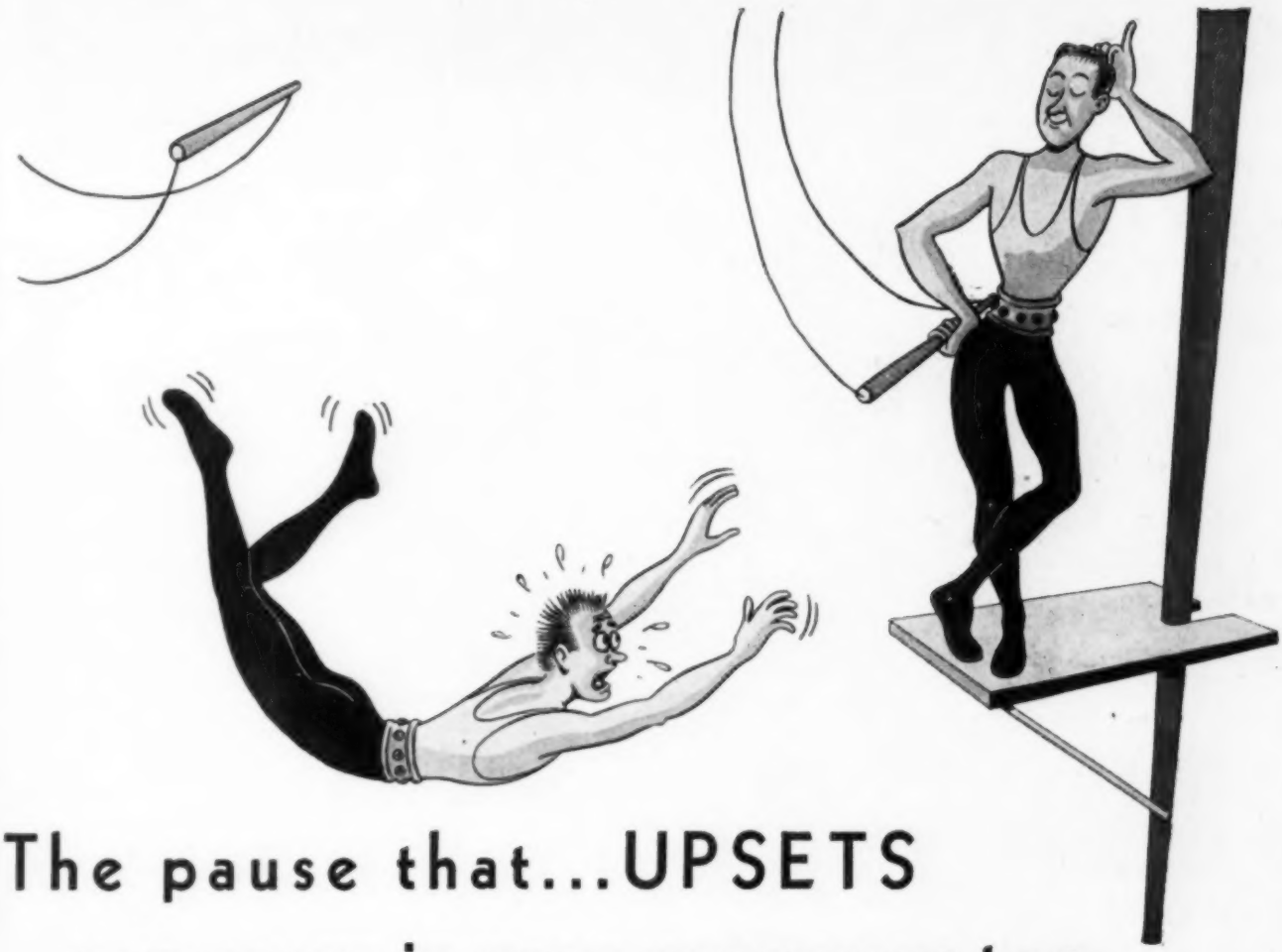

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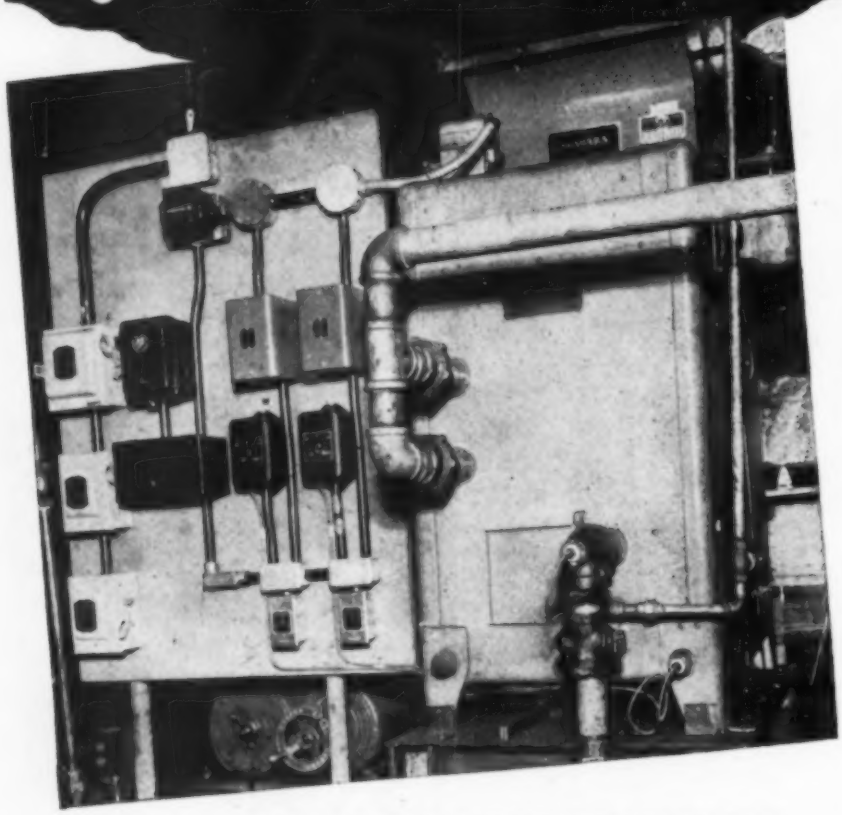

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A New Treatment for Screwworms in Livestock. By C. S. Rude and O. H. Graham, Bureau of Entomology and Plant Quarantine, E-708. Mimeographed.

Federal Legislation, Rulings, and Regulations Affecting the State Agricultural Experiment Stations. Revised September 1946. Department of Agriculture, Miscellaneous Publication No. 515. Price 15 cents.

Directory of the Meat Inspection Division. Corrected to July 1, 1946. Department of Agriculture, Production and Marketing Administration. Unnumbered. Price 15 cents.

Agricultural Outlook Charts, 1947. Book 1. Department of Agriculture, Bureau of Agricultural Economics. Mimeographed.

A Comparison of the Durability of 23 Urea Resins in Glue Joints Exposed to Nearly Saturated Air at 73° C. (167° F.) By A. E. Gabriel. Forest Products Laboratory, Madison, Wis. No. 1355. Mimeographed.

Rate of Development of Joint Strength by Four Resin Glues on Eight Species of Wood. By W. Z. Olson, et al. Forest Products Laboratory, Madison, Wis. No. 1547. Mimeographed.

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Deterioration of Fiberboard by Molds. By George H. Englerth. Forest Products Laboratory, Madison, Wis. Forest Pathology Special Release No. 29. Mimeographed.

Rules, Policy, and Acts. July 1, 1946. Federal Trade Commission. Unnumbered. Price 25 cents.

Industrial Electric Power in the United States, 1939-1946. Available only from Federal Power Commission, Washington 25, D. C. Price 50 cents.

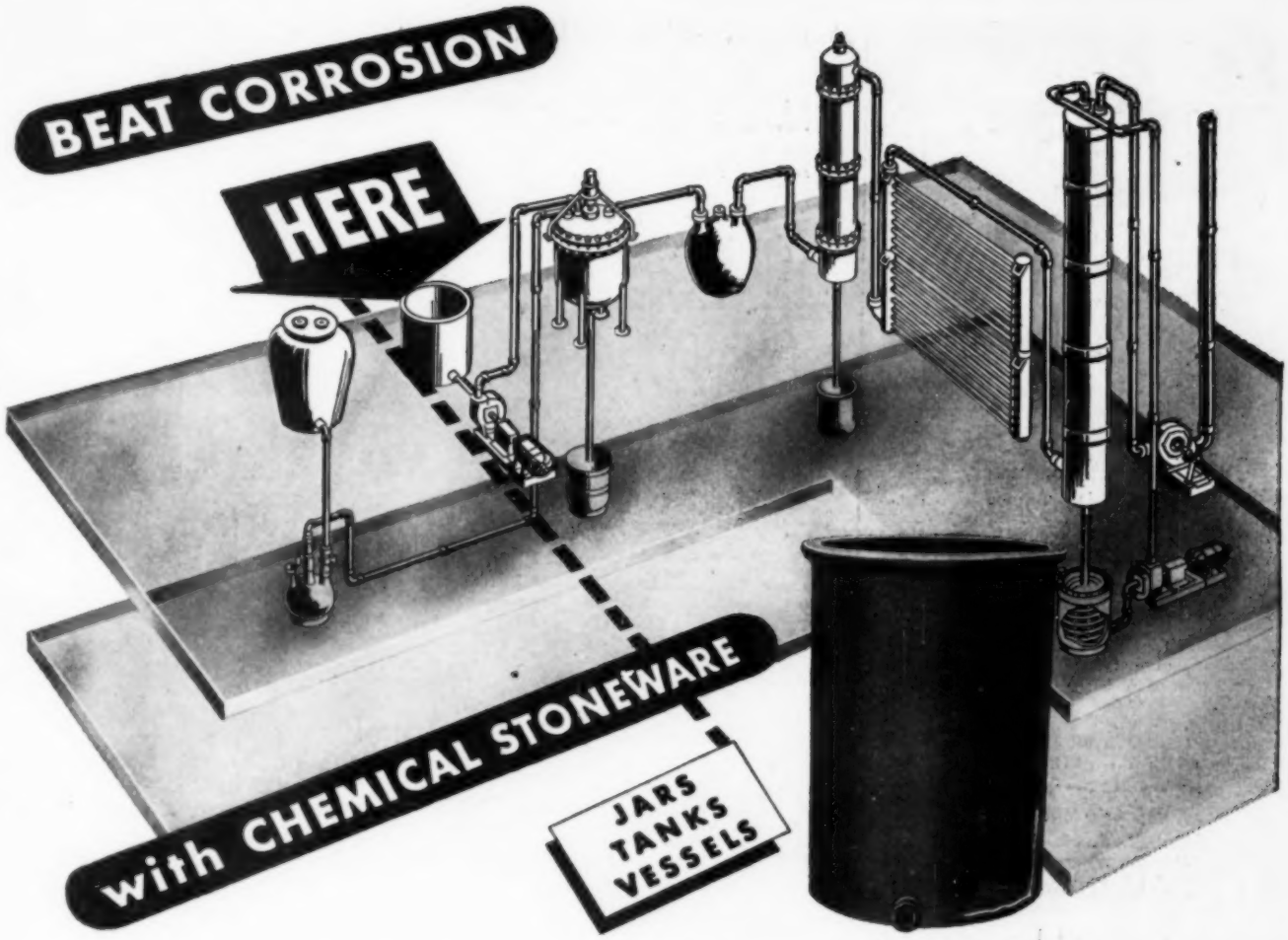
Report on the Rubber Program, Year 1945. Supplement No. 1. Office of Rubber Reserve, Reconstruction Finance Corporation, Washington 25, D. C.

Safeguarding Military Information. Army Regulations No. 380-5. War Department.

Legislative History of the Administrative Procedure Act. Senate Documents 248, 79th Congress. Price 50 cents.

International Control of Atomic Engery. Department of State Publication 2661. Price 30 cents.

Federal Specifications. New or revised specifications which make up Federal Standard Stock Catalog have been issued on the following items: Acetone O-A-51b. Leather; Harness, Vegetable-Tanned KK-L-171b. Leather; Hydraulic-Packing, Mineral-Tanned KK-L-177a. Brick, Fire-Clay HH-B-671c. Paper; Bond, White and Colored UU-P-121d. Paper; Ledger UU-P-12kd. Paper; Ledger UU-P-288a. Paper; Manifold UU-P-328d. Primer-Surfacer; Synthetic, Tints and White (for metal and wood hospital furniture) TT-P-659. Price 5 cents each.



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1

Building Material Specialties. Hill Bros. Chemical Co., Los Angeles, Calif.—34-page catalog listing properties, specifications and prices of this firm's line of building material specialties, including plastic magnesite, asbestos, oxychloride cement colors, flexible plaster, oxychloride cement, calcium chloride and clay materials. Gives detailed illustrations for preparation and applications.

2

Castings. Ampco Metals, Inc., Milwaukee, Wis.—Bulletin 53A. 4-page leaflet pointing out the benefits derived from using centrifugal castings.

3

Cement Mill Equipment. American Manganese Steel Division, Chicago Heights, Ill.—Bulletin 1043-BM. 36-page bulletin containing information on the use of manganese steel for cement mill equipment. Development of manganese steel is described and its manufacture discussed. Contains large number of photographs of various pieces of equipment made from manganese steel.

4

Chemicals. Phillips Petroleum Co., Bartlesville, Okla.—Bulletin No. 150 is a 4-page leaflet featuring the application of Soltrols (low odor petroleum naphthas) for use in insecticides, odorless paints, dry cleaners, home cleaners, solvents, and chemical intermediates. Contains a table of properties for three different grades.

5

Chemicals. Westvaco Chlorine Products Corp., New York, N. Y.—Technical bulletin No. 203 is a 9-page booklet giving properties, composition, range, analysis and uses of hydrogen bromides anhydrous and hydrobromic acid (48 percent aqueous). Contains information on various reactions to these products with reference to the applicability of hydrogen bromide anhydrous as a catalyst, bromination, esterification, condensation, alkylation, isomerization, oxidation and addition compounds.

6

Conveyors. E. C. Horne Machinery Co., Denver, Colo.—Bulletin 100. 4-page folder giving the specifications, outstanding features and industrial applications of a new portable, flexible and reversible power-driven conveyor that can operate around curves. Illustrated with photographic reproductions and line drawings.

7

Couplings. Farrel-Birmingham Co., Inc., Ansonia, Conn.—Bulletin 447 contains 46 pages and describes various types of couplings for use in industrial and marine service. Gives description of coupling functions, plus recommendations of the correct types for specific applications. Contains engineering data with ratings, dimensions and weights.

8

Degreasing Equipment. Mechanical Process Co., South Orange, N. J.—8-page booklet illustrating and describing the various types of degreasing equipment made by this company. Includes specifications of the various types of equipment. Includes photographs of equipment and sketches showing operation.

9

Dehumidifiers. Pittsburgh Lectrodryer Corp., Pittsburgh, Pa.—Bulletin 105 is a 36-page illustrated booklet describing many of the standard sizes and types of equipment for preventing entrance of moisture into storage tanks and for removing oil vapor from compressed air or gases. Covers application of dehumidification equipment in the industrial field, metallurgy, pharmaceutical industry, and the oil and gas industry.

10

Displacement Meters. Roots - Connersville Blower Corp., Connersville, Ind.—16-page bulletin No. 40-B-14 illustrates and describes the positive displacement meters manufactured by this company. Construction features are shown as well as a table of sizes, capacities. Various applications are illustrated and described.

11

Drilling Mud Treatment. Page Laboratories, Ventura, Calif.—16-page illustrated booklet describing this company's Solite process for the conditioning of water to be used in controlling viscosity of oil well drilling muds. Describes advantages of Solite, methods of use and field results.

12

Fans. The Duriron Co., Inc., Dayton, Ohio. —Bulletin 112 is a 12-page booklet on Durco

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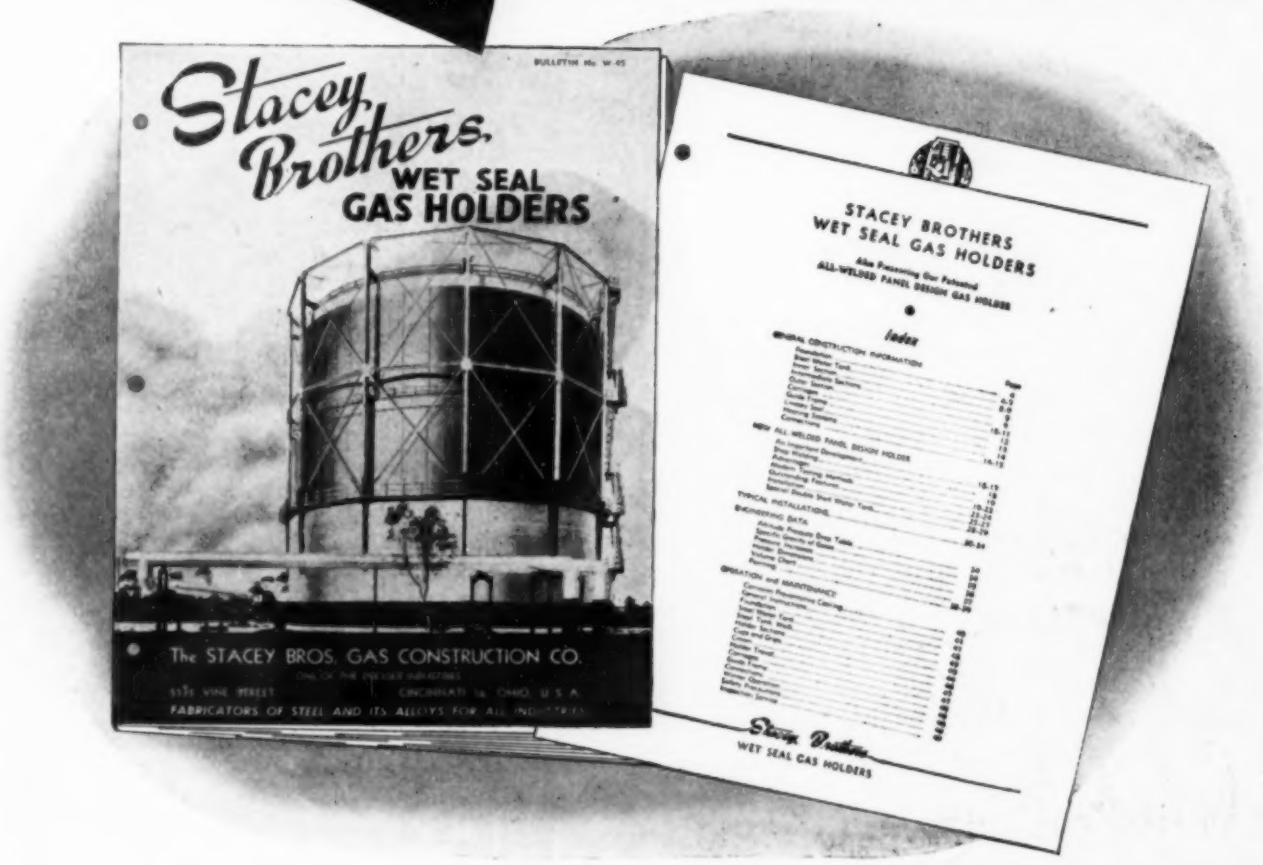

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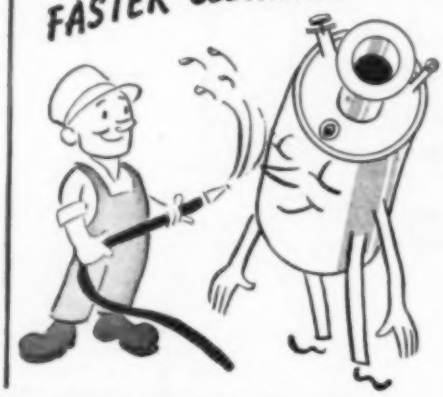

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corrosion resistant fans for exhausting acids and other corrosive fumes. A description of Duriron, Durichlor and Durimet corrosion resisting alloys is included. Typical applications are shown.

13

Filters. Selas Corp., Philadelphia, Pa.—8-page illustrated booklet describing pressure filters which utilize micro-porous filter media for continuous filtration of pharmaceutical, bacteriological, biological, fine chemical and food products.

14

Plexiglas. Rohm & Haas Co., Washington Square, Philadelphia, Pa.—7-page mimeographed bulletin entitled "The Thermal Properties of Plexiglas." Contains information on coefficient of expansion, specific heat, and gives a method for calculating total heat transfer. Contains several graphs showing the relationship of heat transfer to air speed. Also a 4-page mimeographed folder which gives an alignment chart for calculating heat transfer from air to air through Plexiglas panels.

15

Fluid Drive. Link-Belt Co., Chicago, Ill.—Bulletin 2085. 16-page illustrated booklet describing the Electrofluid drive packaged power unit for use in industry. Construction details are shown by cutaway views and ratings and dimensions are tabulated.

16

Grinding Mill. Hardinge Co., Inc., York, Pa.—2-page sheet featuring the Hardinge pilot plant for laboratory units for wet grinding and a similar unit for dry grinding.

17

Grinding Mill. Morehouse Industries, Los Angeles, Calif.—4-page folder describing the advantages and outstanding features of this firm's new model high-capacity SR 1400 Hy-R-Speed mill for grinding, emulsifying, homogenizing, mixing, dispersing and disintegrating. Gives dimensions and cross sectional views. Also a 4-page folder describing use of the same mill in the paint and pigment field.

18

Heat Exchangers. Southwestern Engineering Co., Los Angeles, Calif.—Bulletin No. 403. 12-page illustrated booklet describing the heat exchanger manufactured by this company. Contains information on long tube heat exchangers, reboilers, and short tube heat exchangers. It is well illustrated with photographs of the various types of equipment.

19

Homogenizer. A. T. Case Co., Monrovia, Calif.—4-page illustrated sheet describing outstanding features and applications of this firm's emulsifier-homogenizer in the chemical, paint and varnish, petroleum, pharmaceutical and other industries.

20

Hose. B. F. Goodrich Co., Akron, Ohio.—6-page folder showing the application of this company's fire hose.

21

Instruments. Bacharach Industrial Instrument Co., Pittsburgh, Pa.—4-page folder No. 341-N illustrates and describes the Fyrite CO_2 indicator for gas analysis work. Operation is described. Contains illustrations of the equipment.

22

Instruments. Brown Instrument Co., Philadelphia, Pa.—Catalog 15-10 is a 24-page booklet illustrating and describing the Electronik strip chart potentiometer made by this company. Contains specifications for the various models and shows construction details of various components in photographs. Catalog 5902 is a 24-page illustrated booklet featuring the New-matic air operated remote transmission instruments made by this company. Contains schematic diagrams showing construction and application. Operating features are fully explained and illustrated.

23

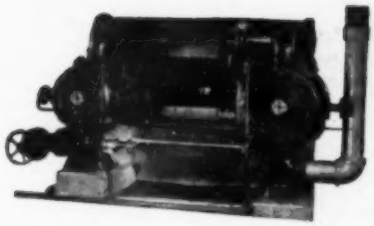
Instruments. Claude S. Gordon Co., Chicago, Ill.—4-page leaflet featuring the Xactline straight line temperature regulator available from this company. Operation is described and a number of applications are listed.

24

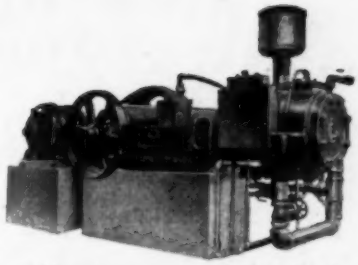
Instruments. Electronics Division, Sylvania Electric Products, Inc., New York, N. Y.—6-page reprint entitled "A New Type of Recording Dilatometer" which illustrates and describes this equipment. Principles are discussed. Also Bulletin No. EC-21 illustrating and describing the Sylvania type 135 automatic recording Dilatometer capable of measuring the thermal expansion of a wide variety of materials including metals, glasses, ceramics and plastics.

25

Instruments. Radio Corp. of America, Camden, N. J.—2 page leaflet illustrating and de-



The air cylinders in this Gardner-Denver "HA" Horizontal Compressor are especially designed for highest volumetric efficiency and lowest horsepower requirements. Its duoplate valves are cushioned for high delivery capacity, high compression efficiency and lowest power consumption. The class "HA" compressors are available in capacities from 316 to 2012 cubic feet displacement per minute.



Is dust a problem in your plant? This Gardner-Denver Class "RX" Horizontal Compressor is dustproof. And its special design permits complete water jacketing of all valves, air passages and cylinder heads to remove the heat of compression—increasing efficiency and cutting horsepower. The Class "RX" Horizontal Compressors are furnished in sizes from 89 to 1292 cubic feet displacement per minute.

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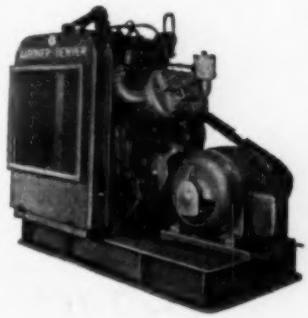
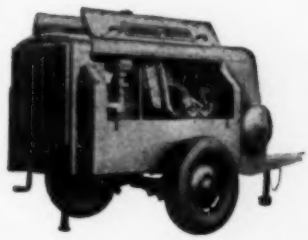
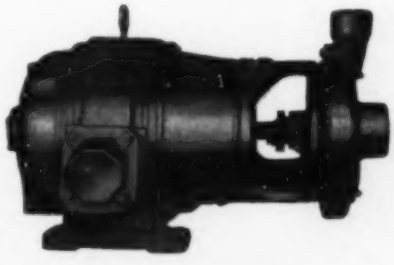


Here's a modern portable air compressor that's mighty handy to have around the plant! Complete water jacketing of its cylinders means dependable operation under constant load—cooler air—lubricating oil economy. Gardner-Denver "Portables" are furnished in sizes to suit every need.



In this Gardner-Denver Close Coupled Centrifugal, see how pump and motor are combined to form a complete, compact unit. These pumps can be installed in any position and are designed for capacities up to 250 gallons per minute, and heads up to 250 feet.



Plant alterations go forward more quickly when your men use this new Gardner-Denver Paving Breaker. The B87 is easier to handle than conventional types—and has a special safety latch which prevents air throttle from being opened when it is moved from place to place. Easily convertible to a sheeting driver.

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26

Instruments. Thermo Electric Co., Fair Lawn, N. J.—Catalog section No. 30 is a 4-page leaflet which illustrates and describes the various types of thermocouple lead wires for use with pyrometers and thermocouples. Contains a table of application information for various types of installations.

27

Insulation. H. I. Thompson Co., Los Angeles, Calif.—6-page mimeographed form describing the new type of high temperature insulating material known as Refrasil, put out by this firm in cloth and bat form. Gives complete specifications as well as physical and chemical properties of this processed silica-fiber material recently developed. Designed to withstand temperatures up to 2,000 deg. F. for sustained periods.

28

Lighting. Lustra Corp. of America, New York, N. Y.—4-page folder illustrating and describing the various types of light bulbs available from this company.

29

Lubrication. Shell Oil Co., Inc., New York, N. Y.—An educational training film entitled "Lubrication of Turbine Systems" produced for the United States Navy Department, Bureau of Ships, is now available to those interested in the operation of turbines. Requires 30 minutes to show and is a 16 mm. black and white sound film.

30

Magnetic Pulley. Stearns Magnetic Mfg. Co., Milwaukee, Wis.—Catalog 303 contains descriptive data, specifications, and information on selecting the proper sizes, materials, capacities and other information.

31

Materials Handling. Crescent Truck Co., Lebanon, Pa.—4-page leaflet featuring the electric Palletier fork lift truck available from this company. Details of operation and application are illustrated by sketches.

32

Materials Handling. Vaughan Motor Co., Portland, Ore.—16-page booklet illustrating and describing the application of this company's Mobilift fork lift truck.

33

Materials Handling. Whiting Corp., Harvey, Ill.—44-page illustrated catalog describing this company's line of Pour-Rite ladles used in foundry work.

34

Packing. France Packing Co., Philadelphia, Pa.—An illustrated folder entitled "Industrial Packing" describes various types of metal packing made by this company.

35

Piping. John B. Astell & Co., Inc., New York, N. Y.—4-page folder describing the stainless steel pipe, tubing and fittings available from this company. Different types of fittings are illustrated.

36

Piping Equipment. Chicago Metal Hose Corp., Maywood, Ill.—New booklet featuring the compensator manufactured by this company for absorbing motion inherent in general pipeline applications. Contains diagram of typical compensator applications and installations, gives data on compensator working pressures and standard fittings, and contains other information on application of the compensator to piping which is subject to corrosion, expansion, temperature, deflection and other movements.

37

Plastic Molding. Tennessee Eastman Corp., New York, N. Y.—35-page book entitled "Tenits Injection Molding" deals with all aspects of the injection molding process: the choice of material; preparation of material for molding; proper design of products to be molded; injection molding machine; mold design and construction; and the various methods of finishing. Contains illustrations of cross sectional drawings of the operations in general use in this process and gives various examples of typical mold designs for different products.

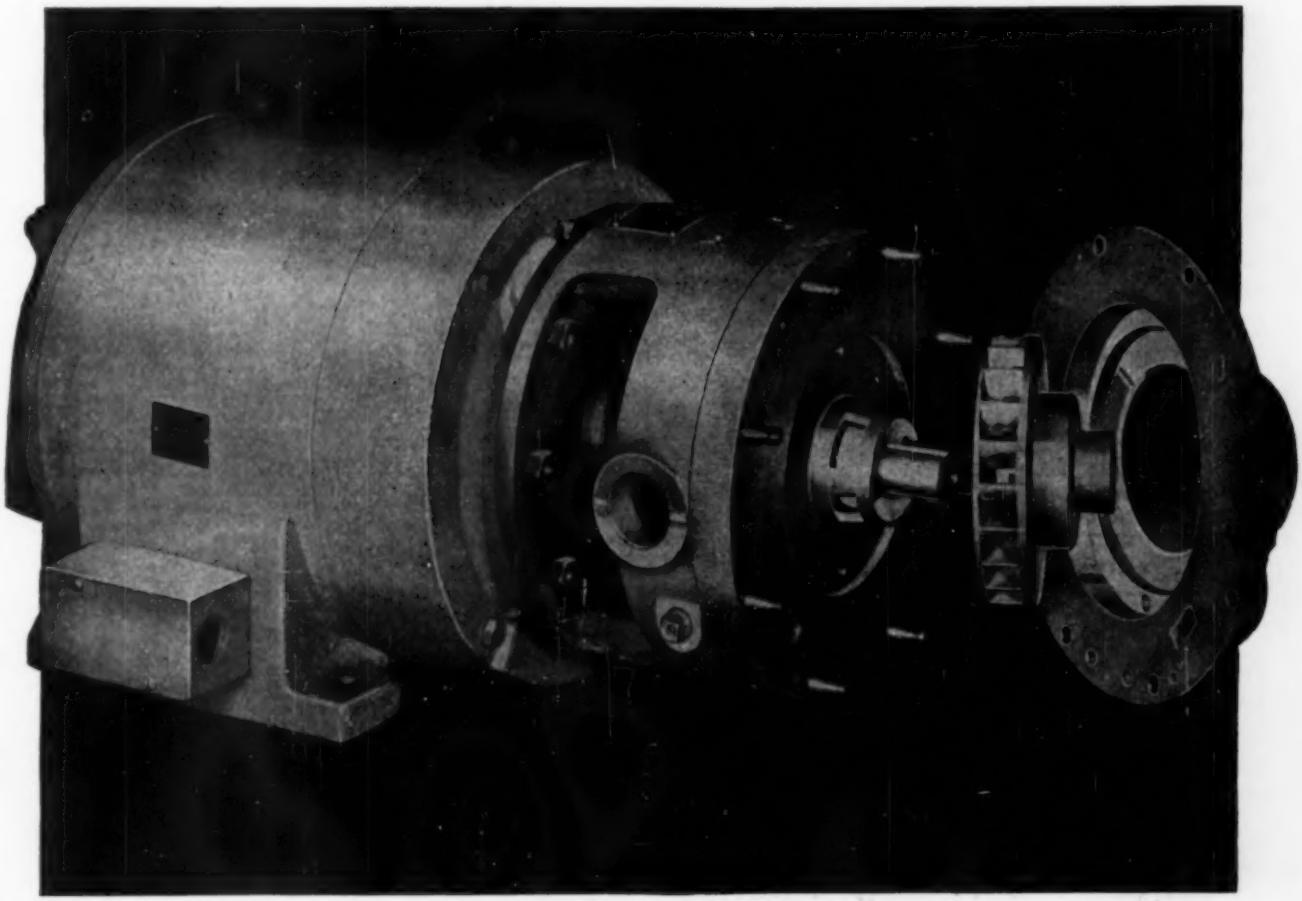
38

Plastics. B. F. Goodrich Chemical Co., Cleveland, Ohio.—12-page illustrated booklet covering properties and processing information on Kriston, the thermosetting resin made by this company.

39

Plastics. Hercules Powder Co., Wilmington, Del.—30-page illustrated brochure featuring the cellulosic plastics made by this company. Well

The Nash Clean-Air Compressor has but one simple moving part.



The Nash Clean-Air Compressor has but one moving part, cast in one piece and rotating in the pump casing without metallic contact. No internal lubrication is necessary; therefore air or other gas compressed with a Nash is entirely free from oil contamination.

Dust and heat are removed from the air, or gas compressed, by the unique Nash "Liquid Piston". Air from a Nash Compressor is therefore delivered free from dust, heat, or oil, without supplementary filters or air washers, in a perfected mechanical structure with no internal wearing parts.

Air or gas from a Nash Compressor may be used for agitating, blending, maintaining pressure on storage tanks, or moving liquids and materials by pressure displacement, in connection with the most delicate food, beverage, or chemical process, without danger of contamination.

Bulletin D-252 tells all about Nash Clean-Air Compressors, and it is free on request.

THE NASH ENGINEERING COMPANY

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THE BUFFALO WIRE CLOTH MAN!

My wardrobe is the most complete you've ever seen. I'm ready for any occasion, to withstand everything from ordinary wear to rust, corrosion and excessive heat.

TODAY I'M GALVANIZED AFTER WOVEN

COATED? EVERY BIT OF ME!

Know why? I'm hot dipt. But first I'm cleaned. Then, mind you, I'm pickled. Just try and work my coating loose!

AM I SMOOTH? AM I BRIGHT?

I'll say I am! I've just the right amount of zinc. Not too much. That would cause "points". Not too little. That would cause "pitting". Brother, I'm Controlled.

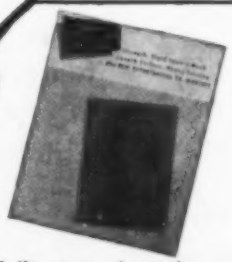
TAKE A LOOK AT MY NODES!

Ever see anything like them? Course not! They're sealed closed. Why, my joints are so smooth that one week I'm a tobacco apron and the next I'm a rayon conveyor.

LIKE MY SHAPE?

True and flat, isn't it? Stays that way, too! You don't see me buckling when I'm rolled out. Cut me into small pieces if you like. I'll still be square and rigid.

DON'T TAKE MY WORD FOR ALL THIS — Write my manufacturer for FREE FOLDER 597.



A valuable piece of literature about the unusual strength, firmness and wearing qualities; smooth surface, faster screening and accurate mesh of "Buffalo" Galv. After Woven Wire Cloth.

Buffalo WIRE WORKS CO., INC.
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illustrated, this brochure contains illustrations and descriptions of a number of types of products manufactured from this company's cellulose products. Includes a section in tabular form giving physical properties of cellulosic thermoplastic laminates compared with unreinforced thermoplastic and thermosetting laminates. Also a table on the effect of different fillers on properties of cellulose acetate laminates. Contains a section on colored cellulose acetate plastics.

40

Power Generation. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—32-page booklet entitled "More Power to U. S. A." which presents the company's equipment available for power generation and distribution. Provides a comprehensive view of this company's power equipment. Bulletin 25C6150.

41

Power Transmission. Patron Transmission Co., New York, N. Y.—General catalog featuring the various lines of speed reducers, gears, belts, chain drives, bearings and other transmission equipment handled by this company. Contains complete description, data and prices for each item listed.

42

Protective Clothing. B. F. Goodrich Co., Akron, Ohio.—10-page booklet featuring the complete line of industrial protective clothing made by this company.

43

Protective Coatings. Hercules Powder Co., Wilmington, Del.—4-page folder listing this company's products used in protective coatings. Includes brief information on why specific products are used for the indicated purpose shown in the table.

44

Protective Coatings. Wailes Dove Hermiston Corp., Westfield, N. J.—26-page booklet featuring the Bitumastic coatings made by this company. Contains information on a wide variety of applications for this coating.

45

Pulp Washing. Swenson Evaporator Co., Harvey, Ill.—3 six-color flow diagrams illustrating different systems of pulp washing.

46

Pumps. Byron Jackson Co., Los Angeles, Calif.—Bulletin 46-5000. 12-page bulletin describing the outstanding characteristics, performance and applications of the firm's line of submersible motor-pump units that can be entirely submerged in water at any depth. Schematic drawings show principles of operation. Includes data on sizes and capacities of three basic types designed for general deep well applications, for low capacity and high head operation and for high capacity and low head operation.

47

Pumps. Milton Roy Co., Philadelphia, Pa.—14-page reprint entitled "Electronics in Automatic Chemical Feed Systems."

48

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin W350-B1H. 20-page booklet illustrates and describes the type CG acid and alkali resistant pumps. Contains sectional diagrams, performance curves, specifications and applications.

49

Refractories. A. P. Green Firebrick Co., St. Louis, Mo.—4-page folder describing the services offered by the A. P. Green Engineering & Management Co. for building and operating firebrick or allied clay product plants outside continental U. S. A.

50

Resin Seal. Plastics Division, American Cyanamid Co., New York, N. Y.—4-page booklet describing the use of Laminac, a polyester resin for sealing micro-porous flaws in castings as well as for providing a surface film to prevent steam corrosion.

51

Safety. American Optical Co., Southbridge, Mass.—A new eye safety guide lists industrial eye hazards by industries and recommends the proper protective equipment. Covers information on 17 industries.

52

Safety Equipment. Mine Safety Appliances Co., Pittsburgh, Pa.—8-page catalog of this company's line of fire protection devices such as goggles, protective lenses, etc.

53

Valves. American Car & Foundry Co., New York, N. Y.—Catalog No. S-46 is a 16-page booklet illustrating and describing the various types of steel lubricated plug valves made by this company. Blueprint sketches are used to illustrate these valves and the dimensions are given in tabular form.

CHEMICAL ECONOMICS

H. M. Batters, MARKET EDITOR

INDUSTRIAL CONSUMPTION OF CHEMICALS REACHED AN ALL-TIME HIGH IN FINAL QUARTER OF LAST YEAR

ALTHOUGH an appreciable increase in production of chemicals in November is indicated by the Federal Reserve Board index which measured industrial chemical output at 410 compared with 400 for the preceding month, the *Chemical Engineering* index for industrial consumption of chemicals did not move correspondingly. The revised index for chemical consumption in October is 216.94 which places it considerably above that for any prior month in the life of the industry. But it dropped back in November to 207.66 with the smaller number of working days, some slowing in operational rates toward the close of the month, scarcity of some raw materials, and inadequate shipping facilities contributing.

A review of production figures for November shows that the majority of chemicals were turned out in smaller volume than in the preceding month but higher outputs were reported for such items as nitric, phosphoric, and sulphuric acids. In fact the figure for virgin sulphuric acid produced set a new monthly record for total acid and for contact acid, but production at chamber plants while unusually high, was not of record volume. Production of soda ash, caustic soda, chlorine, and salt cake, all of which are in small supply, fell rather sharply in November.

Early in December the coal strike and freight embargoes had an effect on general business but conditions improved as the month advanced. The settlement of the maritime strike opened the way for heavy shipments of commodities by water throughout November and December. A typical instance is found in the case of crude sulphur which was moved from mines in record amounts both for domestic account and for export. Complete data on the large consuming industries in December are not yet available but enough information is at hand to assure that industrial consumption of chemicals in the final quarter of last year was the highest ever recorded for a three month period.

Reports on November activities show that most of the chemical-consuming lines cut down their requirements for chemicals and other raw materials. Fertilizer production, however, seems to be holding around its highest point. The output of superphosphate in November was 750,390 tons which was at a higher daily rate than the 754,215 tons produced in October.

The removal of price controls from oils and fats brought immediate jumps in prices but soap makers bought freely at the higher levels and with adjustments in prices for soap, the industry made its best showing of the year in the final months. Crushing mills likewise have been more active and in November processed a total of 1,116,748 tons of oil-bearing materials compared with 988,696 tons in October.

Chemical Engineering Index
Industrial Consumption of Chemicals

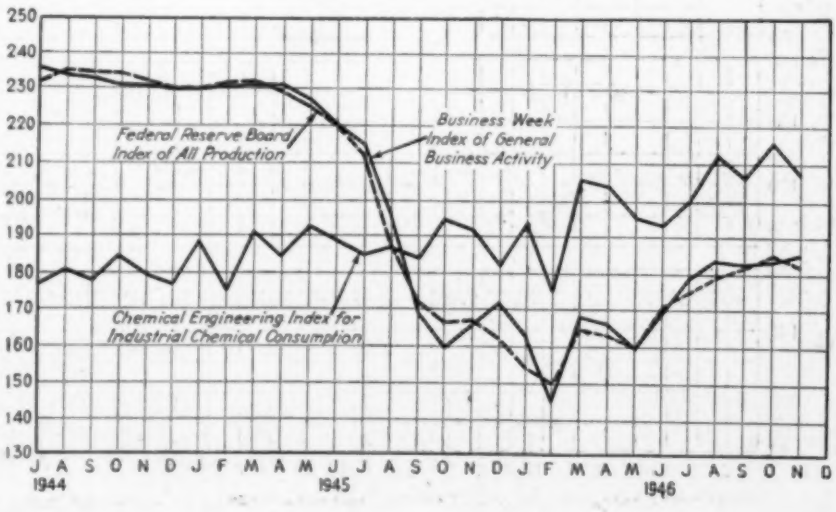
1935 = 100

	Oct. Revised	Nov.
Fertilizers	46.98	46.53
Pulp and paper	23.26	22.33
Petroleum refining	19.45	18.32
Glass	24.04	21.88
Paint and varnish	21.73	21.72
Iron and steel	12.89	11.81
Rayon	20.82	20.39
Textiles	12.30	11.70
Coal products	10.13	9.25
Leather	4.60	4.35
Explosives	7.49	6.63
Rubber	6.75	6.45
Plastics	6.50	6.30
	216.94	207.66

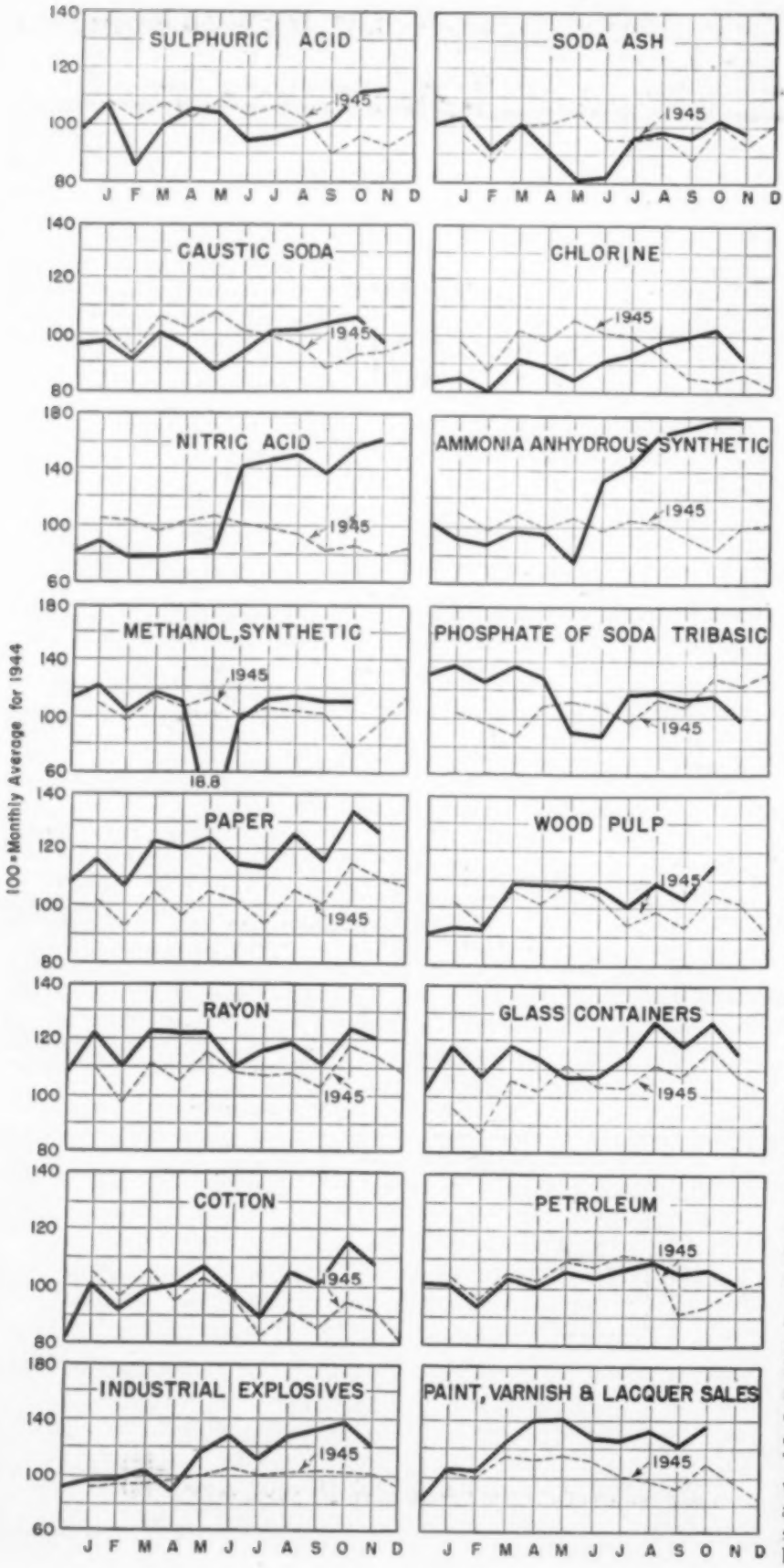
Cottonseed, soybeans, and peanuts were the most important raw materials used with smaller offerings of copra and castorseed holding down the output of those oils. Stocks of tung oil remain low as imports have not yet reached any real tonnage. A lot of 626 tons is on the steamer Stagland which is scheduled to reach New York late this month.

Looking ahead, the regional shippers advisory boards estimate that freight car loadings in the first quarter will run 8.8 percent above the actual loadings in the corresponding period of last year. For chemicals and explosives —they are joined in one classification —an increase of 0.9 percent is estimated for the quarter. For most of the commodity groups the estimates are based on a high percent of the total movement but for chemicals and explosives the estimate gives 54,567 as the total for carloadings and this represents such a small percent that it can not be taken as representative of the industry.

There are of course factors outside the industry, including the possibility of work stoppages, which can destroy the accuracy of any calculated estimate but the lines which offer the largest outlets for chemicals are in a position to continue on a rising curve but the full potential can not be attained because some important raw materials are in short supply and there are not enough freight cars to take care of all requirements



PRODUCTION AND CONSUMPTION TRENDS



WITH PRODUCTION and consumption of chemicals on a broadening scale in the latter part of last year, the industry entered the new year on a higher plane than was case at the beginning of 1946. If labor difficulties do not reach the stage of work stoppages, prospects are favorable for a continuance of current operations for some months ahead. Temporarily prices for the majority of chemicals have been adjusted to the higher costs of production but some dislocations may occur later if higher wage scales become operative.

Predictions have been quite general to the effect that some recession in general business may be expected at some time during the year with va ying views regarding the time when such a movement would become evident. In the chemical process industries there is nothing in sight to warrant belief in any material change from the present level of operations. In fact if the supply of raw materials could be made adequate and if the necessary transportation facilities should be forthcoming, the outlook would favor the moving into higher ground of all chemical-producing lines and the greater part of chemical-consuming industries.

Actually the rising trend is halted not because consuming demand does not exist but because producers are not able to get enough raw materials to bring supply and demand into balance. More specifically, producers of chemicals cannot speed up outputs of the scarcer materials because productive capacities are not sufficient. Consumers of chemicals, in turn, are held back because of the cutbacks they are forced to take in supplies of essential materials. Rayon mills are suffering from a shortage of caustic soda, one mill was closed last month because the plant of its supplier was closed by a strike, but the caustic shortage is affecting all rayon plants.

Cotton textile mills in some parts of the South also are unable to fill their caustic requirements. Glass container plants have the capacity to turn out 125 million gross this year but will not do so because they are not getting as much soda ash as they did a year ago. Paper mills are disturbed because they see no way of covering salt cake requirements with the prospect that the cutback will run as high as 15 percent. The salt cake situation is further aggravated because consumers of soda ash are turning to substitutes where possible and in some cases salt cake is the best substitute for ash.

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- Iron Gluconate
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OVER 50 YEARS
OF AUTOMATIC TEMPERATURE AND HUMIDITY CONTROL

United States Production of Certain Chemicals

October 1946, October 1945 and Ten-Month totals for 1946 and 1945

		October 1946	October 1945	Total, Ten Months 1946	Total, Ten Months 1945
Ammonia, synthetic, anhydrous[1]	Tons	80,829	38,292	563,034	457,90[illegible]
Ammonium nitrate (100% NH_4NO_3)	Tons	85,554	35,301	559,400	.....
Ammonium sulphate, synthetic, technical	M lb.	23,152	17,414	172,759	.....
Calcium arsenate (100% $Ca_3(AsO_4)_2$)	M lb.	1,916	1,304	33,273	.....
Calcium carbide, commercial	Tons	57,074	47,353	462,996	584,097
Calcium phosphate:					
Monobasic (100% $CaH_4(PO_4)_2$)	M lb.	7,305	5,994	60,990	50,757
Dibasic (100% $CaHPO_4$)	M lb.	5,077	8,020	58,256	43,259
Carbon dioxide:					
Liquid and gas	M lb.	10,981	18,308	185,704	180,43[illegible]
Solid	M lb.	54,906	50,502	557,216	581,178
Chlorine	Tons	108,171	99,392	965,553	1,005,896
Chrome green (C.P.)	M lb.	1,378	1,221	15,446	5,928
Chrome orange and yellow (C.P.)	M lb.	3,163	4,680	36,910	34,861
Hydrochloric acid (100% HCl)	Tons	32,394	29,691	280,762	348,535
Hydrogen	M cu. ft.	1,484,000	1,331,000	14,522,000	.....
Lead arsenate (acid and basic)	M lb.	2,259	2,869	50,076	61,225
Molybdate chrome orange (C.P.)	M lb.	440	339	4,208	1,544
Nitric acid (100% HNO_3)	M lb.	61,686	34,262	448,180	382,697
Oxygen	M cu. ft.	1,061,154	915,719	[8]8,832,715	12,160,110
Phosphoric acid (50% H_3PO_4)	Tons	80,536	61,500	715,240	579,219
Soda ash (commercial sodium carbonate):					
Ammonia soda process:					
(98–100% $NaAsCO_3$):					
Total wet and dry[2]	Tons	382,026	381,468	3,230,560	3,640,192
Finished light[3]	Tons	188,119	187,273	1,816,842	1,910,307
Finished dense	Tons	137,295	136,749	1,269,090	1,192,142
Natural[4]	Tons	16,242	14,231	171,919	151,863
Sodium bicarbonate, refined	Tons	16,242	17,182	167,366	142,443
Sodium bichromate and chromate	Tons	7,066	7,347	71,649	66,904
Sodium hydroxide (100% NaOH):					
Electrolytic process:					
Liquid[5]	Tons	105,162	84,289	937,044	953,341
Solid	Tons	19,217	15,884	164,149	180,827
Lime soda process:					
Liquid[5]	Tons	63,336	62,058	616,992	609,375
Solid	Tons	20,125	22,440	195,170	203,181
Sodium phosphate:					
Monobasic (100% NaH_2PO_4)	Tons	988	1,336	9,785	12,296
Dibasic (100% Na_2HPO_4)	Tons	5,253	5,843	48,255	50,632
Tribasic (100% NA_3PO_3)	Tons	7,756	8,678	80,621	71,722
Meta (100% $NaPO_3$)	Tons	2,239	2,657	22,925	22,647
Tetra (100% $Na_4P_2O_7$)	Tons	4,780	4,862	58,230	35,075
Sodium silicate (anhydrous)	Tons	41,188	27,321	345,203	352,612
Sodium sulphate:					
Anhydrous, refined (100% Na_2SO_4)	Tons	10,422	9,005	153,878	66,466
Glaubers salt[6]	Tons	15,316	15,893	147,016	168,737
Salt cake, crude, commercial[6]	Tons	48,367	50,517	388,199	459,503
Sulphuric acid (100% H_2SO_4)[7]					
Chamber process	Tons	273,085	257,264	2,513,480	2,651,616
Contact process, net[8]	Tons	515,307	432,553	4,576,822	4,697,617
Zinc yellow	Tons	291	205	.....	13,296

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census and WPB Chemicals Bureau. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given, data are either confidential or not yet available. [1] Includes a small amount of aqua ammonia. [2] Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3] Not including quantities converted to finished dense. [4] Data collected in cooperation with the Bureau of Mines. [5] Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6] Includes oleum grades, excludes spent acid. [7] Data for sulphuric acid manufactured as a byproduct of smelting operations are included. [8] Revised.

United States Production of Certain Synthetic Organic Chemicals

September 1946, September 1945 and Nine-Month Totals for 1946 and 1945

	September 1946	September 1945	Total, Nine Months 1946	Total, Nine Months 1945
Acetic acid:				
Synthetic	21,933,741	18,373,451	203,560,500	201,990,516
Recovered	96,836,421	.....	862,947,460	.....
Natural[1]	2,655,615	2,438,893	20,558,677	25,815,671
Acetic anhydride[2]	41,209,257	37,789,450	381,867,269	397,185,438
Acetone	29,120,588	.....	244,584,569	.....
Acetylsalicylic acid	573,785	961,996	7,167,442	7,972,955

(Continued on page 284)

MATERIALS of CONSTRUCTION

for Chemical Engineering Equipment

★ Copies of *Chemical Engineering's* Twelfth Report on Materials of Construction are now available. This 96-page booklet gives data on 58 materials used in the process industries. It also includes an article on corrosion problems of the Oak Ridge atomic plant and 8 pages of data and information on gaskets and packings..... **$1**

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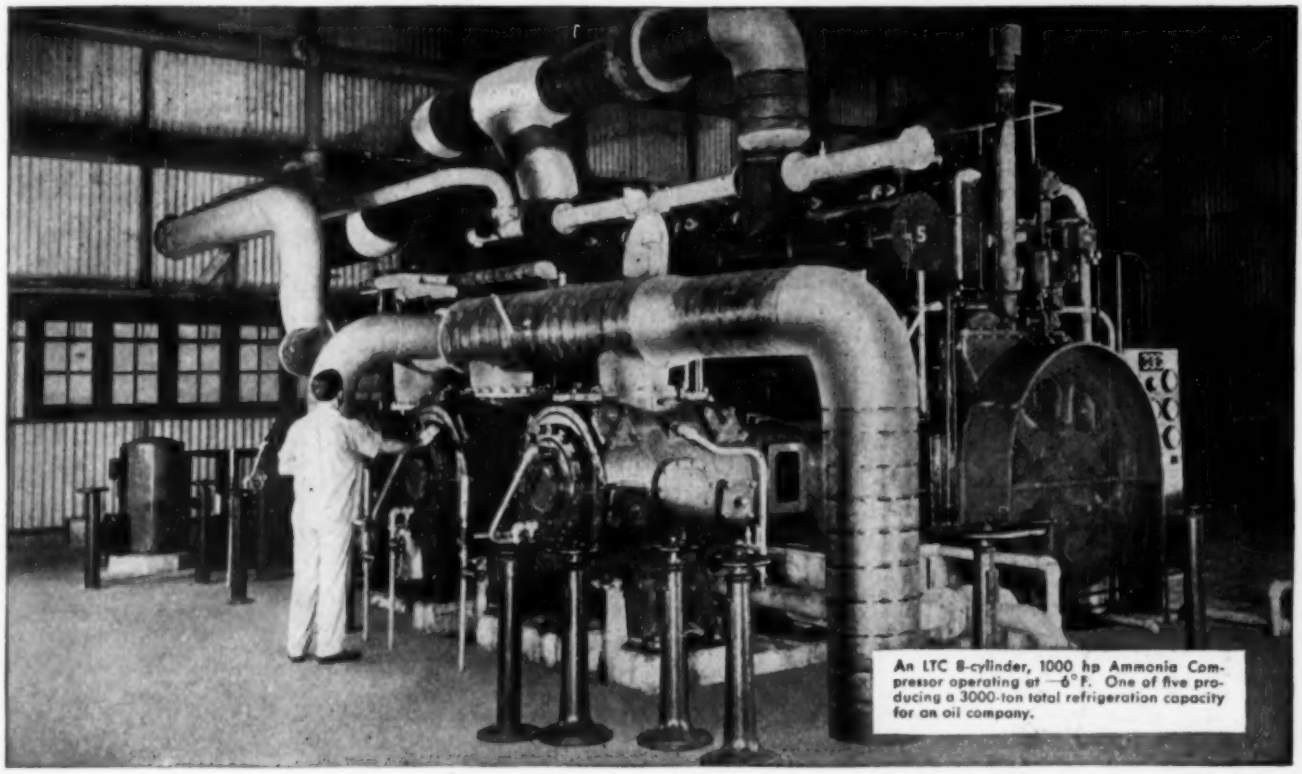
CHEMICAL ENGINEERING • 330 West 42nd St., New York 18, N. Y.



An LTC 8-cylinder, 1000 hp Ammonia Compressor operating at —6° F. One of five producing a 3000-ton total refrigeration capacity for an oil company.

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. . . IN THIS MOST COMPLETE LINE OF ANGLE GAS-ENGINE COMPRESSORS

Whether or not your refrigeration involves special requirements — small floor space, for example — it's a safe bet you'll find exactly the angle gas-engine compressor you're looking for in the complete Worthington line.

That's because Worthington offers you more sizes and larger sizes— five of them, in fact, with from three to eight cylinders, brake horsepower from 400 to 1000 and capacities up to 1000 tons. With this wide range to choose from, and Worthington performance to depend upon, your way to better, more economical refrigeration is clear.

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Worthington Angle Compressors are ruggedly built, down to the smallest detail. There's plenty of reserve power in their conservative rating. There's long, trouble-free service in their smooth operating balance . . . over-all accessibility . . . full force-feed lubrication of running gear . . . extensive water jacket area for power cylinders . . . and extra large diameter crankshaft which assures stiffness and provides large diameter bearings and pins for the running gear.

PLUS "EASY BREATHING"

For smoother, steadier operation under all service conditions, there's nothing in compressor design to equal Worthington's exclusive Feather* Valve. This extremely quiet, easily controlled feature enables maximum flexibility in arranging the compressor element to deliver any combination of volume and pressure within the machine's rating.

IN MAKING YOUR CHOICE

Consider these many advantages, together with great flexibility of operation, compact, space-saving design and low installation cost. They explain why Worthington Angle Gas-Engine Compressors are preferred refrigeration equipment in so many industries . . . further proof that *there's more worth in Worthington*. For complete details, write to *Worthington Pump and Machinery Corporation, Harrison, N. J.*

*Reg. U. S. Pat. Off.

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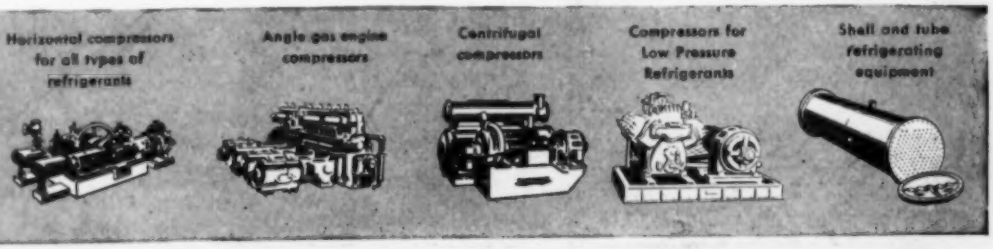
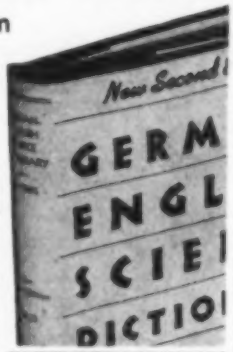

Horizontal compressors for all types of refrigerants
Angle gas engine compressors
Centrifugal compressors
Compressors for Low Pressure Refrigerants
Shell and tube refrigerating equipment

More than 50,000 scientific terms

translated from German to English . . .



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—Thermodynamic Symbols
—Electric Units of Measure
—Abbreviations of Periodicals
—List of Measurements
—Geographic Names
—Chemical Elements
—Electrical symbols

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U. S. Production of Synthetic Organic Chemicals (Cont. from page 282)

	September 1946	September 1945	Total, Nine Months 1946	Total, Nine Months 1945
Aniline	6,316,896	.....	64,272,921	.....
Barbituric acid derivatives:[5]				
5-Ethyl-5-Phenylbarbituric acid and salts (Phenobarbital)	30,853	22,989	291,878	208,286
Benzene:				
Motor grade:				
Tar distillers[4]	572,921	.....	6,977,328	.....
Coke oven operators[6]	2,862,437	.....	22,956,029	.....
All other grades:				
Tar distillers[4]	1,423,526	.....	16,051,778	.....
Coke-oven operators[6]	11,246,342	.....	75,017,789	.....
Butyl alcohol, primary, normal	10,249,071	.....	257,821,246	.....
Carbon bisulphide	26,457,725	.....	220,537,897	.....
Carbon tetrachloride	13,173,641	.....	105,833,090	.....
Chlorobenzene, mono	21,478,919	.....	198,422,522	.....
Creosote oil:				
Tar distillers	11,142,216	9,800,002	96,042,626	96,293,041
Coke oven operators	2,765,474	2,398,293	19,001,732	26,988,502
Cresols:[9]				
Meta-para	804,222	937,129	4,384,092	6,356,255
Ortho-meta-para	380,909	866,487	.....	7,064,931
Cresylic acid, refined[7,11]	2,283,728	2,430,999	17,093,392	22,410,430
Dibutyl phthalate	1,221,936	.....	.....	.....
Dichlorodiphenyltrichloroethane (DDT)	3,855,842	.....	33,302,459	.....
Ethyl acetate (85% by wt.)	7,334,167	6,849,223	67,248,057	82,316,819
Ethyl ether, technical and U.S.P.	3,079,223	4,487,628	27,368,527	64,919,732
Formaldehyde (37% by wt.)	36,735,289	.....	237,289,897	.....
Methanol:				
Natural[3]	1,220,784	[9]1,280,400	11,718,225	[9]14,258,696
Synthetic	43,773,153	40,583,680	360,346,319	376,999,280
Naphthalene:				
Tar distillers (Less than 79° C.)	17,203,040	20,252,928	136,090,019	155,586,622
Tar distillers (79° C. and over)	8,154,983	7,772,986	71,383,059	54,865,362
Coke-oven operators (Less than 79° C.)	7,537,392	7,632,973	48,832,378	67,910,067
Penicillin[8]	2,214,209	.....	29,098,303	.....
Phenol, synthetic and natural	13,734,526	.....	142,864,158	.....
Phthalic anhydride	9,333,857	9,567,194	77,838,138	98,810,416
Styrene (Government owned plants only)	30,613,972	.....	280,617,619	.....
Toluene:				
Coke-oven operators[6]	1,472,380	.....	11,972,632	.....
All other[10]	1,270,104	.....	10,377,837	.....

All data in pounds except benzene (gal.), creosote oil (gal.), toluene (gal.), and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [2] Excludes the statistics on recovered acid. [3] Acid produced by direct process from wood and from calcium acetate. [5] All acetic anhydride including that from acetic acid by vapor-phase process. [4] Product of distillers who use purchased coal tar only or from oil-gas or water-gas produced or purchased by tar distillers. [6] Statistics are given in terms of bulk medicinals only. [8] Statistics collected by Bureau of Mines. [7] Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [9] Reported to U. S. Bureau of the Census. [9] Reported in gal. by Bureau of the Census but converted to lb. for comparison with the production of synthetic methanol. [10] Includes toluene produced from petroleum by any process. [11] Includes refined cresylic acid from petroleum.

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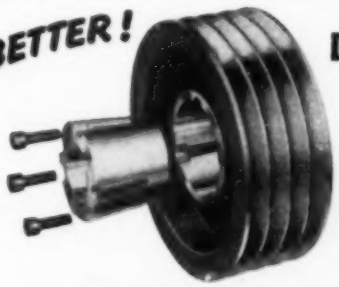

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CHEMICAL ENGINEERING Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

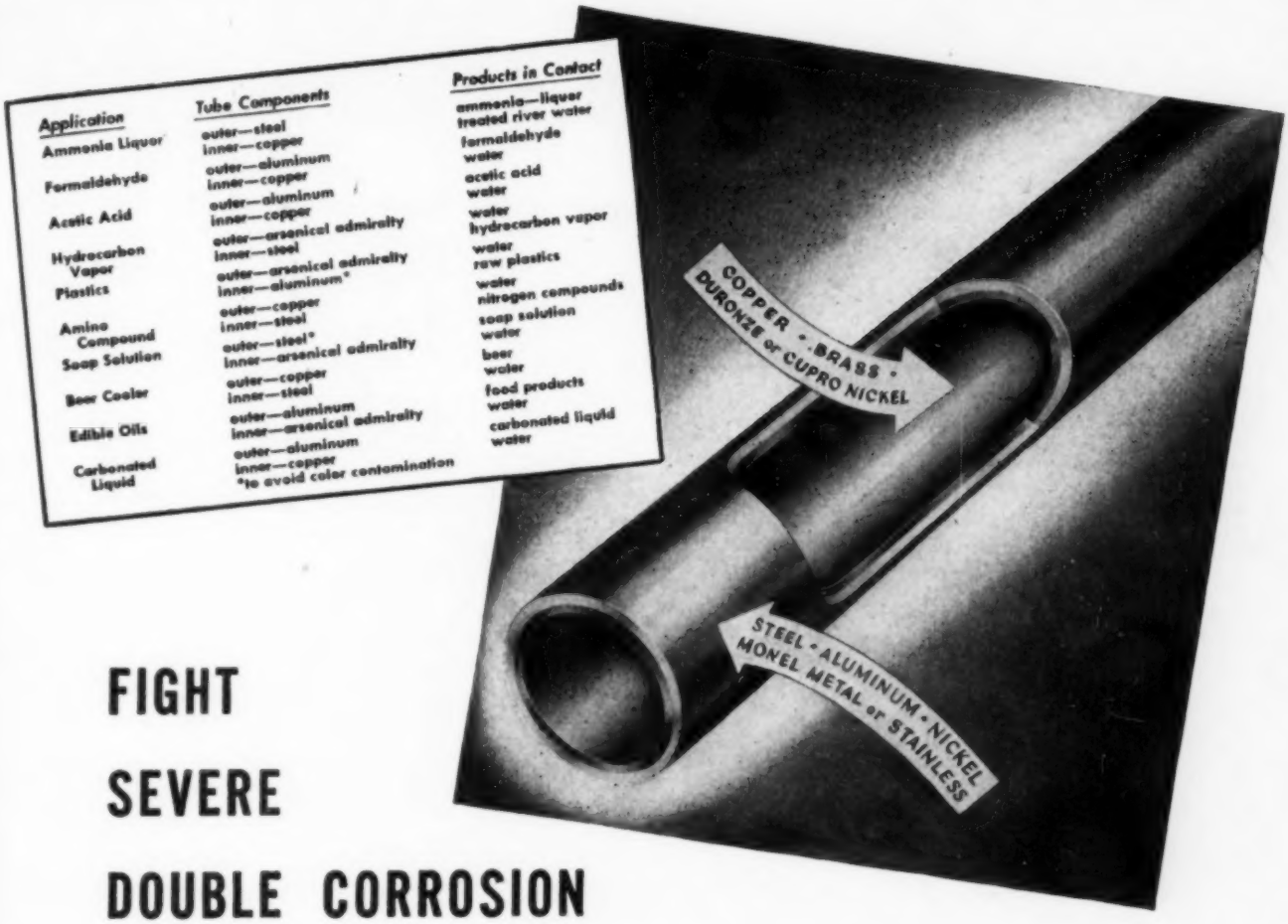
This month	**121.63**
Last month	121.23
January, 1946	109.13
January, 1945	108.81

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell f.o.b. works, quotations are so designated. Prices are corrected to January 13.

INDUSTRIAL CHEMICALS

Acetone, tank, lb	$0.07 –
Acid, acetic, 29% bbl., 100 lb	3.78 – $4.03
Boric, bbl., ton	109.00 – 113.00
Citric, drums, lb	.22½ – .23
Formic, cbys., lb	.12 – .12½
Hydrofluoric, 30%, drums, lb	.08 – .085
Lactic, 44% tech., light, bbl., lb	.073 – .075
Muriatic, 18°, tanks, 100 lb	1.05 –
Nitric, 36°, carboys, lb	.05 – .05½
Oleum, tanks, wks., ton	18.50 – 20.00
Oxalic, crystals, bbl., lb	.13 – .14
Phosphoric tech., tanks, lb	.04 –
Sulphuric, 60°, tanks, ton	13.00 –
Tartaric, powd., bbl., lb	.54½ – .56
Alcohol, amyl from pentane, tanks, lb	.15½ –
Alcohol, butyl, tanks, lb	.14½ – .251
Alcohol, ethyl, denatured, No. 1 special, tanks, gal	.82½ –
Alum, ammonia, lump, lb	.04½ –
Aluminum sulphate, com. bags, 100 lb	1.15 – 1.25
Ammonia, anhydrous, cyl., lb	.14½ –
tanks, ton	59.00 – 61.50
Ammonium carbonate, powd., casks, lb	.09½ – .10
Sulphate, wks., ton	30.00 –
Amyl acetate, tech. from pentane, tanks, lb	.21 –
Aqua ammonia, 26°, drums, lb	.02½ – .03
tanks, ton	65.00 –
Arsenic, white powd., bbl., lb	.06 – .06½
Barium carbonate, bbl., ton	65.00 – 75.00
Chloride, bags, ton	80.00 – 90.00
Nitrate, casks, lb	.09½ – .11
Blanc fixe, dry, bags, ton	60.00 – 70.00
Bleaching powder, f.o.b., wks., drums, 100 lb	2.50 – 3.00
Borax, gran., bags, 100 lb	48.50 –
Calcium acetate, bags, 100 lb	3.00 –
Arsenate, dr., lb	.09 – .10
Carbide, drums, ton	50.00 –
Chloride, flake, bags, del., ton	21.50 – 38.00
Carbon bisulphide, drums, lb	.05 – .05½
Tetrachloride, drums, lb	.06 – .06½
Chlorine, liquid, tanks, wks., 100lb.	2.00 – 2.30
Copperas, bgs., f.o.b., wks., ton	17.00 – 18.00
Copper carbonate, bbl., lb	.23 – .24
Sulphate, bags, 100 lb	7.10 – 7.25
Cream of tartar, bbl., lb	.45 – .50
Diethylene glycol, dr. lb	.14 – .15
Epsom salt, dom., tech., bbl., 100lb.	2.05 – 2.25
Ethyl acetate, tanks, lb	.09½ – .19½
Formaldehyde, 30%, tanks, lb. wks.	.032 –
Furfural, tanks, lb	.09½ –
Glaubers salt, bags, 100 lb	1.05 – 1.10
Glycerine c.p. drums, extra, lb	.55 – .60
Lead:	
White, basic carbonate, dry, casks, lb	.13½ –
Red, dry, sck., lb	.15 –
Lead acetate, white crys., bbl., lb.	.17½ – .18
Arsenate, powd., bags, lb	.20 – .21
Lithopone, bags, lb	.05 – .05½
Magnesium, carb., tech., bags, lb.	.07½ – .08
Methanol, 95%, tanks, gal	.60 –
Synthetic, tanks, gal	.24 –
Phosphorus, yellow, cases, lb	.23 – .25
Potassium bichromate, bags, lb	.10½ – .10½
Chlorate, powd., lb	.11 – .11½
Hydroxide (c'stic potash) dr., lb.	.07½ – .09½
Muriate, 60%, bags, unit	.53½ –
Nitrate, ref., bbl., lb	.08½ – .21
Permanganate, drums, lb	.20½ – .20
Prussiate, yellow, casks, lb	.19 – .20
Sal ammoniac, white, casks, 100lb.	4.50 – 5.00
Salsoda, bbl., 100 lb	1.10 – 1.20
Salt cake, bulk, ton	15.00 –
Soda ash, light, 58%, bags contract, 100 lb	1.20 –
Dense, bags, 100 lb	1.28 –
Soda, caustic, 76% solid, drums, 100 lb	2.50 –
Acetate, del., lb	.05½ – .06
Bicarbonate, bags, 100 lb	2.25 –
Bichromate, bags, lb	.08 – .08½
Bisulphate, bulk, ton	16.00 – 17.00
Bisulphite, bbl., lb	.03 – .04



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In ammonia refrigeration systems and in processes involving amino compounds, Duplex Tubing of steel to the ammonia side and a copper-base alloy to the water side has been successful. There are many other applications in the handling of beverages, drugs, food products, gums, oils, resins, and raw materials used in the manufacture of plastics. Various combinations are available, such as Duronze IV* (arsenical aluminum bronze), Cuzinal (aluminum brass), Cupro Nickel, Admiralty, Muntz, Red Brass, or Copper combined with steel, stainless, monel or aluminum.

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NEW CONSTRUCTION

	Current Projects		Cumulative 1946	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	$1,275,000	$1,470,000	$7,556,000
Middle Atlantic	$1,055,000	6,150,000	27,151,000	44,627,000
South	.....	42,000,000	66,382,000	165,763,000
Middle West	.....	5,630,000	16,677,000	76,077,000
West of Mississippi	3,036,000	17,675,000	107,111,000	170,465,000
Far West	1,568,000	905,000	15,458,000	34,814,000
Canada	.....	.....	2,230,000	18,665,000
Total	$5,659,000	$73,635,000	$236,479,000	$517,967,000

Proposed Work

Calif., Los Angeles—Zellerbach Paper Co., 3000 East 12th St., plans to construct a 400x1,000 ft. warehouse. Estimated cost $969,000.

Md., Baltimore—Mutual Chemical Co., 13th and Block Sts., plans to rehabilitate its plant. Sanderson & Porter, 52 William St., New York, N. Y., Archts and Engrs. Estimated cost $1,000,000.

Mo., Kansas City—Mid West Research Institute, c/o G. E. Ziegler, 4449 Pennsylvania Ave., plans to construct a laboratory. Wight & Wight, First National Bank Bldg., Archts. Estimated cost $1,000,000.

N. Y., Long Island City—Lion Match Co., 250 West 57th St., New York, N. Y., plans to alter its factory building. Alexander Crossett, 27 William St., New York, Engr.

Okla., Tulsa—Carter Oil Co., 1133 North Lewis St., plans to construct additions to its research laboratory. A. M. Atkinson, 502 Thompson Bldg., Archt. Estimated cost $225,000.

Ore., North Portland—Western Waxed Paper Co., Box 518, plans to construct a 1 story, 85x86 ft., 30x117 ft. and 40x72 ft. additions to its plant. Whitehouse, Church & Roehr, Builders Exchange Bldg., Portland, Archts. Estimated cast $81,000.

Ore., Portland—Stauffer Chemical Co., Suttle Rd., North Portland, plans to construct a 1 story, 66x98 ft. warehouse for agricultural chemicals. Estimated cost $68,000.

Tex., Amarillo—Texoma Natural Gas Co., Chicago, Ill., plans to construct a dehydration plant addition here, also improvements and additions to gasoline plant and additions to nine compressor units. Estimated cost $225,000, $375,000 and $900,000 respectively.

Tex., Corpus Christi—Tex-Mex Cement Co., Corpus Christi, plans to improve and enlarge its plant. Estimated cost $310,500.

Wash., Tacoma—St. Regis Paper Co., Kraft Pulp Div., 801 Canal St., plans to construct a 2 story, 140x140 ft. and 32x60 ft. main barking building, ship silos, etc. Estimated cost $450,000.

Contracts Awarded

Calif., Redwood City—Chemical Process Co., 58 Sutter St., San Francisco, has awarded the contract for a test laboratory and factory building to Wagner & Martinez, 181 South Park, San Francisco. Estimated cost $250,000.

Calif., Richmond—Stauffer Chemical Co., 636 California St., San Francisco, has awarded the contract for a fertilizer plant addition to C. Norman Petersen, 70 Rock Lane, Berkeley. Estimated cost will exceed $55,000.

Calif., Salinas—International Minerals & Chemical Corp., Box 647, San Jose, and Spreckels Sugar Co., 2 Pine St., San Francisco, have awarded the contract for alterations to existing plant building here (structural steel work) to Herrick Iron Works, 18th and Campbell Sts., Oakland. Total estimated cost $600,000.

Conn., Groton—Charles Pfizer & Co., Inc., 11 Bartlett St., Brooklyn, N. Y., has awarded the contract for alterations and additions to existing chemical plant buildings here to W. J. Barney Corp., 101 Park Ave., New York, N. Y. Estimated cost $1,275,000.

Fla., Cantonment—Florida Pulp & Paper Co., P. O. Box 1591, Pensacola, Fla., has awarded the contract for a pulp and paper mill to Merritt-Chapman & Scott Corp., 17 Battery Pl., New York, N. Y. Estimated cost $12,000,000.

Ill., Chicago—Pure Carbonic, Inc., 166 West Jackson Blvd., has awarded the contract for a factory and office building to Abell-Howe Co., 53 West Jackson Blvd. Estimated cost $560,000.

Kan., Kansas City—Colgate-Palmolive-Peet Co., 105 Hudson St., Jersey City, N. J., has awarded the contract for a factory building to Turner Construction Co., 420 Lexington Ave., New York, N. Y. Estimated cost $60,000.

N. J., Hamilton Township (Trenton P. O.)—Sloane Blabon Corp., Bear Swamp Rd., Trenton, has awarded the contract for the design and construction of a factory for the manufacture of plastics, also office building, to W. Kidde Constructors, Inc., 140 Cedar St., New York, N. Y. Estimated cost $1,375,000.

N. J., North Bergen—Grand City Container Corp., 622 West 57th St., New York, N. Y., has awarded the contract for the construction of a paper products manufacturing plant on Tonnelle Ave., to S. S. Silberblatt, Inc., 25 West 45th St., New York, N. Y. Estimated cost $2,000,000.

N. J., Pennsauken—Attapilgas Clay Co., 260 South Broad St., Philadelphia, Pa., has awarded the contract for alterations and additions to its plant here to Lauter Construction Co., 112 South 16th St., Philadelphia. Estimated cost $55,000.

N. Y., Syracuse—Bristol Laboratories, Inc., Chimes Bldg., has awarded the contract for the design and construction of a drug manufacturing plant to H. K. Ferguson Co., 19 Rector St., New York, N. Y. Estimated cost will exceed $2,000,000.

O., Dayton—War Dept., Washington, D. C., has awarded the contract for the construction of an atomic energy plant here to be operated by Monsanto Chemical Co., 1700 South Second St., St. Louis, Mo., to Maxon Construction Co., 131 North Ludlow St., Dayton. Estimated cost $5,000,000.

Pa., Jeannette—American Window Glass Corp., 1073 South Main St., has awarded the contract for an addition to its factory to Groomes Construction Co., Highland and Spruce St., Cheswick, Pa. Estimated cost $53,000.

Pa., Linfield—Publicker Alcohol Co., 1429 Walnut St., Philadelphia, has awarded the contract for an addition to its plant to McCloskey Co., 1620 West Thompson St., Philadelphia, at $106.750.

Pa., McKees Rocks—Federal Enameling & Stamping Co., McKees Rocks, has awarded the contract for a 5 story plant to P. S. Edwards, R. F. D. No. 1, Library, Pa. Estimated cost $60,000.

Pa., Philadelphia—Gulf Oil Corp., 30th and Penrose Ave., has awarded the contract for the construction of a Polyform unit at its plant to The Lummus Co., 420 Lexington Ave., New York, N. Y. Estimated cost $3,500,000.

S. C., Rock Hill—Celanese Corp. of America, Cumberland, Md., has awarded the contract for the construction of a plant to manufacture cellulose acetate and celanese yarns spun from cellulose acetate to Daniel Construction Co., Po. O. Box 2087, Greenville, S. C. Estimated cost $30,000,000.

Tex., Corpus Christi—Southern Alkali Corp., Corpus Christi, will enlarge its dry ice plant. Work will be done by force account. Estimated cost $500,000.

Tex., Henderson—Henderson Clay Products, Henderson, will construct a clay products manufacturing plant. Work will be done by owners. Estimated cost $115,000.

Tex., Houston—Shell Oil Co., Shell Bldg., has awarded the contract for the construction of a lubricating oil manufacturing plant to Lummus Co. and M. W. Kellogg Co., Mellie Esperson Bldg. Estimated cost $10,000,000.

Tex., Houston—Shell Oil & Refining Co., Chemical Div., Shell Bldg., has awarded the contract for a plant to manufacture synthetic glycerin to C. F. Braun & Co., Mellie Esperson Bldg. Estimated cost $7,000,000.

Wis., West De Pere—Nicolet Paper Corp., West De Pere, has awarded the contract for repairing its factory building to C. R. Meyer & Sons Co., 50 State St., Oshkosh, Wis. Estimated cost $70,000.